Emirates Green Building Council

Technical Workshops

2016 Briefs

Emirates Green Building Council (EmiratesGBC) Technical Workshops are intended to gather EmiratesGBC members and partners on a monthly basis to discuss specific topics that are relevant and beneficial to the green building industry.

As a knowledge-sharing platform, the workshops allow EmiratesGBC members to highlight challenges and solutions in their specific areas of work, and to exchange with professionals from other companies, sectors, and areas of the green building industry. They also support the EmiratesGBC objectives to be an active and pro-active knowledge center to its members.

EmiratesGBC
مجلس الامارات للابنية الخضراء
Emirates Green Building Council

The Emirates Green Building Council was formed in 2006 with the goal of advancing green building principles for protecting environment and ensuring sustainability in the United Arab Emirates.

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Disclaimer:

This paper provides overall guidance on principles only, and needs to be read in conjunction with the references given below. All projects have individual and differing requirements, and the contents of this paper are generic. The contents of this paper need to be interpreted to suit the individual project requirements.

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EmiratesGBC Technical Workshop #2016-1

Outdoor External Comfort

January 12, 2016

Introduction

One of the key challenges when designing outdoor spaces in the GCC is minimizing the impact of the high summer temperatures. Typically, between the months of April and October the combination of air temperature, solar exposure and heat island effect, due to built-up urban spaces, renders the external spaces in the GCC unbearably hot. By prolonging the number of hours that the outside space is habitable, this serves the dual purpose of improving the bottom line for the end client in relation to maximizing the amount of time the retail customers can spend outdoors and improving the social cohesion of community developments.

Understanding how the pattern of use changes for each month of the year – with extended use during the winter months, dwindling down to a minimum in the summer time – is important when assessing thermal comfort. Tackling this issue and attempting to prolong the 'habitability' of external spaces is a key issue to be addressed in any contemporary development in the GCC.

In January, the EmiratesGBC monthly Technical Workshop addressed how computational fluid dynamics (CFD) simulation can assist in developing a systematic approach to the study of comfort for external environments in the region.

Background

Defining and measuring outdoor thermal comfort

Following an introductory round of presentations during which they were asked to share their expertise and reasons to attend this specific workshop, participants were introduced to the concept of outdoor thermal comfort, which can be defined as the way modern design studies the combination of microclimate conditions, human thermal psychological and physiological factors that ensures satisfaction and comfort of the occupants. Parameter influencing thermal comfort include microclimatic

ones (Direct and diffuse solar radiation, Air temperature and humidity, Air velocity and turbulence) as well as physiological ones (clothing and activity level).

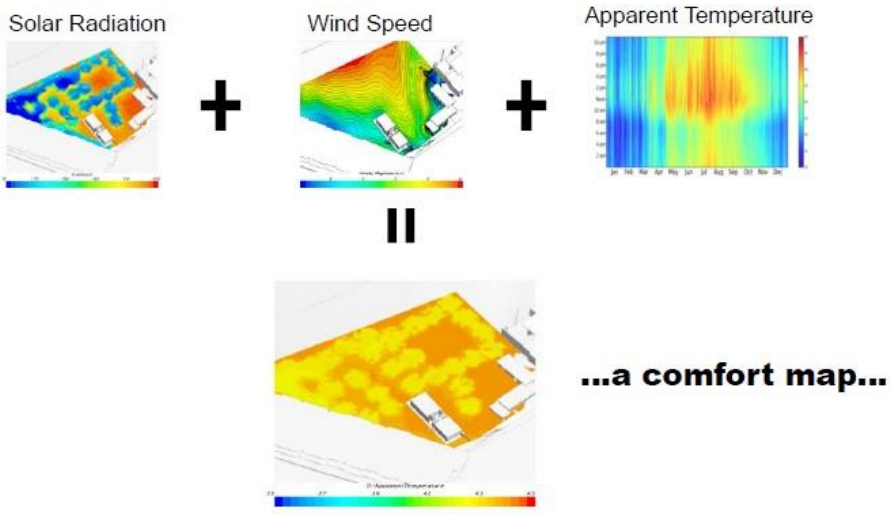
Because “comfort’ can also be understood in a rather subjective manner, existing models have been developed to capture outdoor thermal comfort, with the first two as the most commonly used:

- Physiological Equivalent Temperature (PET) calculated from the mean radiative temperature, air temperature, air velocity and water vapour pressure;
- Apparent temperature (AT) which takes into account the actual temperature at skin level;
- Others, such as Predicted Mean Vote (MPV), Heat Index, Wind Chill, Perceived Temperature (PT), Standard Effective Temperature (SET)

Testing Methodologies

While it is obviously easier to test indoors conditions in terms of installing sensors to test scenarios, capture changes and survey occupants’ comfort, outdoor thermal analysis requires a more thorough and long-term analysis of conditions which are meant to evolve from one day to the other, leading to a less accurate modelling.

The traditional approach to identify and map outdoor thermal comfort would consider different field testing options and indicators (solar radiation, air velocity, apparent temperature…) separately. Consultants have now been using a more holistic methodology which implies connecting indicators with one another in order to design one unique map compiling all aspects. This methodology was used in the below-mentioned case studies.

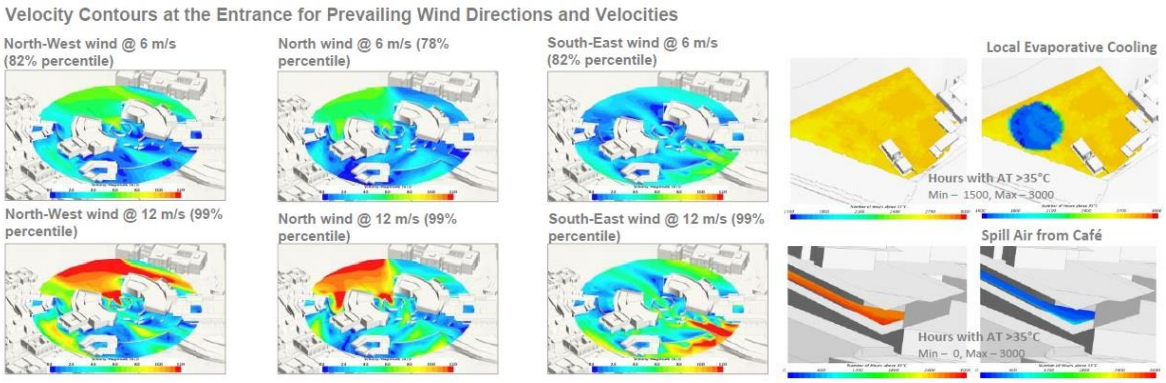


The purpose behind the research

There has always been a general wish to better apprehend local climatic conditions during the summer season, characterized by very high temperatures and humidity rate. Business owners have been especially interested in expanding the time that people can spend outdoors in order to increase the number of potential clients and thus maximize profit associated with outdoors activities (leisure, F&B). In a broader understanding the usage of outdoor areas in restaurants, resorts and other leisure-driven developments in locations such as Dubai has a much bigger impact on the high level as it directly connects with the city's image and tourism potential. The consultants' expertise combined with climatic modelling and field testing therefore support the owners' financing modelling and business development.

Case study for discussion

To illustrate the above-mentioned points, the workshop participants were presented with two case studies, allowing them to review the methodology followed by the consultants to test and assess thermal comfort and the solutions that were provided to the project owner accordingly.



For both projects taking place in Qatar (wellness resort-left) and in the UAE (hospitality and F&B-right), the consultants have used computational fluid dynamics (CFD) analysis for wind velocity, wind direction, solar radiation and apparent temperature analysis for the owners to optimize the usage of their outdoors space without compromising the comfort and satisfaction of the clients.
In these specific cases, the analysis led the consultants to suggest the following responses:

- non-action, i.e. confirming that comfort is not affected by the wind in view of the building's existing location and position);
- use of wider canopies for improved comfort and reduced irrigation;

- installation of localized evaporative cooling and spill air inclusion for areas adjacent to air-conditioned spaces.

Discussion points

A standard for outdoor thermal comfort?

The ANSI/ASHRAE Standard 55 already "specifies conditions for acceptable thermal environments and is intended for use in design, operation and commissioning of buildings and other occupied spaces". With this standard in mind participants were asked whether the development of a standard dedicated to outdoor thermal comfort would be relevant in the region. The following were discussed:

- Existing standards such as ASHRAE do not take into consideration the local climatic conditions and would therefore need to be combined with many other factors to be properly adapted to the local context.
- A standard does not provide all answers as many factors cannot be addressed through it such as psychological aspects or subjective body resilience.
- "Benchmarking comfort" and providing targets could be more relevant especially during extreme weather conditions, to understand the needs for various types of buildings and lifestyles and design more accurate comfort maps.
- Health and safety should be considered as equally in the region, particularly for the occupants (e.g. workers) that are spending the majority of the time outdoors.

Design, equipment and subjective perceptions

The participants then had the opportunity to review and discuss the results of the various analysis and comment on the consultants' recommendations. The following aspects were raised:

- Focus should be on the building's existing characteristics rather than on the equipment installed to compensate comfort outdoors. Integrative and/or passive design methodologies are key to success while appropriate landscaping should provide natural shading without compromising the outdoor areas' original purpose.
- Following the above, it is critical to understand the practical aspects behind the usage of a specific location and make relevant decisions in terms of materials and equipment to use accordingly. For instance, if one considers a café located on an outdoor terrace exposed to the sun and winds, one should not only use sun radiation and air velocity as

decisional factors; one should for example also consider the in-and-out continuous movements of staff and guests; the exposure to the HVAC outtakes from the inside to outside; the lack of space to install tailored equipment.

- Behavioural aspects are as important as technical ones: some participants highlighted the fact that guests/occupants should just not be proposed to used outdoor areas when the weather conditions are too extreme (too hot, to humid) especially during the peak of the summer season. Comfortable temperatures through HVAC, whether inside or outside, has become an expectation which often leads to energy wastage.

Conclusion

Because people spend more than 90 % of their time indoors in the region, it is often expected that the time spent outdoors remains as controllable and enjoyable. The extreme weather conditions, particularly during the summer season, oblige however to rethink the usage of these spaces and to apply different methodologies allowing designers and consultants to maximize comfort while reducing the negative impacts on the occupants' health, on the owners' business opportunities and on the overall energy consumption. Combining these three aspects however is key to understand the technical limitations of existing assessment methodologies and standards: there is a trade-off between the wish to increase outdoor comfort by decreasing the temperature and the negative impact this has on energy consumption.

References | Recommendations for Further Reading

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EmiratesGBC Technical Workshop #2016-2:

Renewable Energy Technologies for High-Rise Buildings

January 21, 2016

Introduction

Renewable energy technologies are more easily applied/installed on low-rise buildings compared to high-rise ones due to the limited space available on the roof of high-rise buildings. This is largely because these roofs are mostly occupied with other installations such as cooling towers, chillers and other equipment.

Understanding the challenges to convert the facades of existing buildings or to design multifunctional facades for harvesting renewable energy is important to promote renewable energy systems on high-rise buildings.

On the 21st of January 2016, EmiratesGBC conducted a Technical Workshop during the World Future Energy Summit (and discussed the challenges and opportunities for installing renewable energy systems on high-rise buildings.

Definition of High Rise Buildings

The definition of high-rise buildings, tall buildings, and skyscrapers differs between countries. A common definition of high-rise buildings is tall buildings used for residential or commercial purposes. They are commonly characterized with having a high elevation and a significantly small rooftop to total area ratio.

Buildings with over 50 stories are usually considered as skyscrapers. The UAE's skyline is dominated by skyscrapers, with Dubai for example having over 3000 high-rise buildings in a 30 km radius.

Traditional Renewable Energy Technologies

Standard solar panels/ collectors installed on building's roof

Traditionally solar panels (either solar thermal collectors or solar photovoltaics panels) are installed on the roof of buildings. These installed solar panels benefit from the available area on

the roof for production of electricity. A downside to this strategy is that roof areas cannot be used anymore for leisure/touristic activities such as for swimming pools or restaurants. The solar systems installed on the roof of high-rise buildings are also considered small scale systems compared to the load of the overall building thus the price per KW is higher compared to larger scale systems and there are lower economic savings achieved

Wind turbines installed on the roof or on balconies

The power production of wind turbines installed on roof or on balconies is not optimized due to the turbulent flow of wind at higher elevations. Moreover, noise and vibration generated by wind turbines are also major challenges for the buildings themselves.

It is important to note that the increase in the height of a building would increase wind speeds but this doesn't mean higher wind power potential. This is largely due to the presence of turbulence generated by the building itself and the surrounding obstacles.

Potential of biomass energy

Offsite biogas production: Due to the higher residential density (number of residents per unit area of a property) of vertical developments compared to horizontal communities, the rate of organic waste generated per unit of area is typically higher per unit area. This waste can be collected and used for offsite generation of biogas (methane).

Vertical developments are attractive for collection of organic waste in terms of the relatively large amount collected from a specific area and the lower transportation/collection costs.

On-site biomass boilers: Biomass boilers (wood-pellet boilers) can be used either for space heating or for domestic hot water production. However, their application in the UAE has several challenges. First, these boilers are limited in size and are unable to cover the huge hot water requirements of high rise buildings. Second, the centralized production of hot water would require a legal structure/framework/ contract between tenants and building owners.

Creative applications for high rise buildings

Solar walls- Trombe Walls

A Trombe wall is an important sustainable architectural feature that aides in the ventilation, heating, and surprisingly, cooling of buildings.

Classical Trombe Wall:

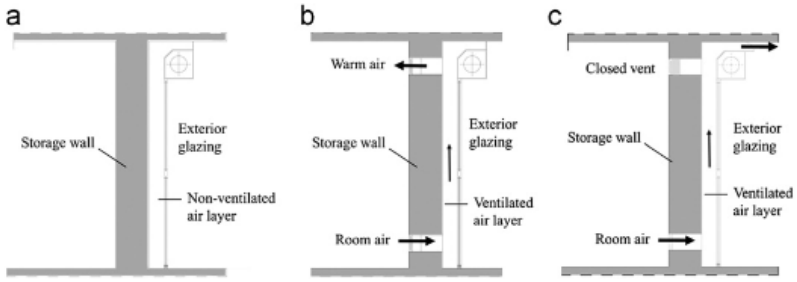

Fig. 1. Various configurations of a solar wall: (a) without ventilation; (b) winter mode with air thermo-circulation; (c) summer mode with cross ventilation [32].

The wall absorbs diffused and direct solar radiation during the day and during the night transfers the heat to the interior of a thick storage mass wall by convection or conduction. The gap between the glass and the wall normally ranges from 3 cm to 6 cm. The heat that is stored in the thermal mass is released gradually.

In order to increase the effectiveness of the classic trombe walls, a dark coating is applied on the outer surface to increase absorptivity.

The limitation of classical trombe walls is their effectiveness in heating rather than cooling which makes this technology not applicable in hot climates such as in the MENA region.

A hybrid prototype Trombe wall: the ceramic evaporative cooling wall. The wall functions as a classic solar wall during winter and provides cooling in summer.

The wall employs an external thermal insulation blind during summer to avoid any direct solar gain. Moreover, a special type of ceramic is used in the interior wall known as porous ceramic, which absorbs a significant amount of water. In hot weather, the ceramic is wetted by a water nozzle installed at the roof over the gap between the glass and the wall, which causes the gap to function as a cooling chamber due to the evaporative cooling phenomenon

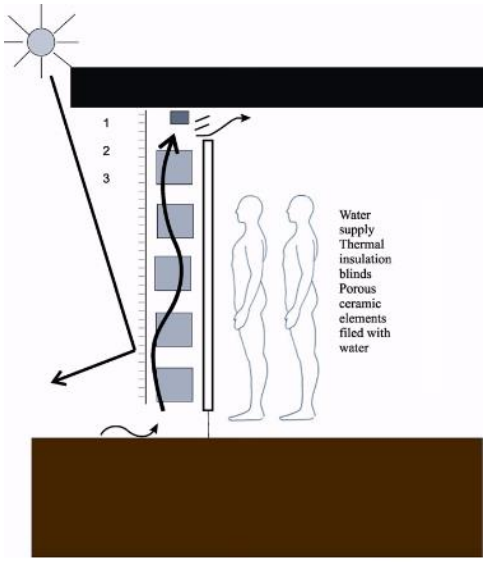

Fig. 8. Solar ceramic evaporative cooling wall [55].

Solar Facades

There are three main goals for considering solar facades on high-rise buildings: architectural aspects, power generation, and/or lighting control. Some buildings use these façades to show environmental and social responsibility of the developers/owners/end-users. They also add a marketing value.

The solar facades can be building integrated also known as BIPV or not integrated but connected to façades in the form of overhangs or louvres.

Building Integrated Photovoltaic System

Building-integrated photovoltaics (BIPV) are photovoltaic materials that are used to replace conventional building materials in parts of the building envelope such as the roof, skylights, or facades. BIPV systems are not installed – BIPV panels are part of the building itself and they are there to stay.

Types of BIPV

- Glass Solar Panels: Also known as G2G (glass to glass), these solar panels have solar cells encapsulated between two layers of glass when crystalline silicone is used or frameless thin film panels. Thin film panels are more suited to the GCC region as they are less sensitive to temperature fluctuations. It should be noted that their relatively lower efficiency is made up for by their longevity and relatively greater output over a longer lifespan.
- Crystalline Silicone: represent 90% of the market.
- Mono Crystalline - can achieve 19% efficiency
- Poly Crystalline – can achieve 13% - 15% efficiency
- Thin film: α Si (amorphous silicon) – CdTe (cadmium telluride) – CIGS (copper indium gallium selenide)– CIS (copper indium selenide)

As a reaction to the high price of crystalline panels, necessity led to the invention of thin film solar technology which has become a successful discipline itself in the PV domain.

- **Roof Integrated Solar Panels**: Flexible thin film is a relatively new product with easy installation features. A drawback again is low efficiency compared to crystalline panels, but this can be offset with the eliminated cost of needed mounting structures which can take up to 5% of an installation project, and more for rooftop.
- **Solar Tiles**: Offer full integration as a building material than roof rack-mounted systems. These are also composed of thin film technology and subsequently have low power generation capacity. An advantage to this technology is zero mounting costs and a negligible load on roofing structures.

Building Integrated Wind Turbines

Usually large wind turbines are located away from human dwellings in rural areas. This is because in urban areas or cities there is a significant hazard of rotating machinery, vibrational load, noise generation, and possible collapse of machinery. In addition, wind turbines are subject to turbulence necessitating frequent repairs.

Proper aerodynamic design of buildings ensuring laminar flow of wind would help in designing effective building intergated wind turbines. Moreover, modern wind turbines have safety features including speed controls and controls that stall turbines in storms. An important design aspect to ensure optimal operation of wind turbines is placing them above the turbulence zone.

The operation/output of integrated wind turbines is still a controversial topic. There is no sufficient existing operational testing guidelines on how these turbines operate.

As an ionic example, the World Trade Centre in Bahrain has adopted the building integrated wind turbine concept. This system is composed of three wind turbines, each supported by 30-meter bridges between 2 towers. These turbines provide up to 30% of the building's energy requirements.

Figure 8. Three wind turbines at The World Trade Centre towers in Bahrain.

Challenges of adopting renewable energy technologies on high-rise buildings

1. The roof area is often relatively small compared to the entire building envelope.
2. Furthermore, the roof area of high-rise buildings is often completely occupied by equipment for technical building services such as cooling towers, chillers and similar installations.
3. The installation of renewable energy systems on high-rise buildings necessitate the customization of building components. Such building integrated facade components have to be customized so that they meet the individual requirements of the building under consideration such as size, wind load, and safety barrier function. Such customized components will be manufactured in most cases by local manufacturers on demand.
4. The number of buildings which have to renovated is large, which brings to question the investment amount needed as well as labor capital necessary to undertake these retrofits.
5. Lack of awareness about the cost-effectiveness of renewable energy technologies.

Opportunities, Supporting Schemes and Importance of Integration

1. Fundamental transformation of the construction sector is necessary in order to streamline the fragmented responsibilities and to develop business models which are attractive for third-party financing.
2. Development and implementation of new and highly advanced integrated cost-effective façade concepts, based on new multifunctional components and/or new combinations of (improved) existing building envelope technologies would create a huge opportunity for the spread of the RE market on high-rise buildings.
3. The importance of considering integrated design: integrated design is different than conventional design in its focus on active collaboration between a multidisciplinary team. There are three types of integration:

- Physical integration: is fundamentally about how components and systems share space, that is, how they fit together
- Visual integration: involves development of visual harmony among the many parts of a building and their agreement with the intended visual effects of design. This may include exposed and formally expressive components of a building that combine to create its image.

- Performance integration: has to do with “shared functions” in which a load-bearing wall, for instance, is both envelope and structure, so it unifies two functions into one element. In a direct-gain passive solar heating system, for example, the floor of the sunlit space can share the thermal work of the envelope and the mechanical heating systems by providing thermal mass and storage.

Integration, resulting in simplicity, yields not only order but long-term economy. The break-even point of intersection in figure below between the two curves depends upon the size and complexity of the building. Integrated innovative design does not necessarily represent high additional costs, although as shown in figure below the initial costs may be higher than that of conventional design with incomplete integration. However, its benefits are immense in that operating costs are lower and energy costs could be substantially lower compared with conventional solutions. With continued implementation of integration techniques even initial costs eventually level off.

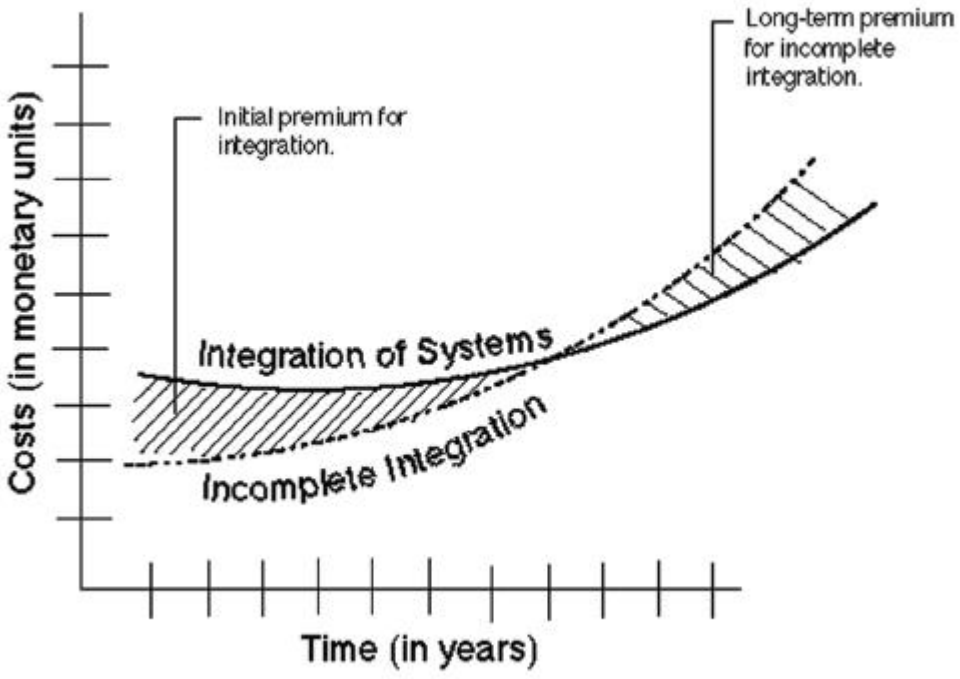

Figure 1: Cost-Effectiveness of Integration

The regulatory framework and the business environment for the construction sector has changed significantly in order to reduce the CO2-emissions from existing and new buildings. This plays a

great role in spreading the generation of renewable energy in high-rise buildings. For instance, the Green Building Regulations and Specifications in Dubai and the minimum requirements under Estidama Pearl Rating System in Abu Dhabi are ionic achievements in this regard.

Estidama Pearl Rating System and other international ratings system (such as LEED) give credits for onsite renewable energy production. Moreover, Dubai Electricity and Water Authority promotes micro solar system installation on commercial and residential buildings.

Q&A

Effectiveness of evaporative cooling in the UAE

For sure, the efficiency of evaporative cooling is highly effected by the level of humidity. As the relative humidity increases, the efficiency of evaporative cooling system decreases.

The solution for that is the use of desiccant dehumidifiers to remove the humidity thus making evaporative cooling feasible in the UAE.

Additional Costs of Solar Walls

The additional costs associated with solar walls are the initial costs of glazing, fan, and/or ventilator systems. Moreover, the operating costs include the maintenance and the cleaning costs.

Usually when evaluating the effectiveness of solar walls, it is beneficial to consider a life cycle assessment where the savings in the HVAC requirements are considered and recognized. Such energy efficiency measures have economic impact after several years of installation.

Table Discussions

Topic 1: What actions would best lead to widespread use of on-site renewable energy resources on high rise buildings?

- Participants discussed several factors that would lead to widespread use of renewables on high rise buildings. These factors are summarized below:
- Awareness about the effectiveness and affordability of renewable energy technologies:
- Sitting issues (solar access protection, homeowner association restrictions, etc.)
- Reduced cost of renewables and the presence of financing mechanisms
- Code enforcements and unified regulations

- Proper scheme between tenants and building owners

Topic 2: In your opinion, should renewable energy requirement for high rise buildings be prescriptive, performance-based (based on percent of overall-building load) or outcome-based (set overall building energy use target and let builder/designer/owner determine how to meet it). Is the market ready for such requirements?

Participants were divided between 2 categories: Performance and Outcome-Based.

Considering a performance based requirement would encourage building owners to decrease their consumption. The reduction of the demand would decrease the renewable energy requirement thus requiring a smaller renewable power system installed (lower initial cost). A major challenge in considering performance based requirements is the difficulty applying it in existing buildings. A solution for that can be purchasing renewable energy credits to comply with the requirement.

On the other hand, the reduction of energy demand and the adoption of energy efficient equipment are more cost-effective than the installation of renewable power systems. This can be the reason for a preference towards outcome based requirements.

Topic 3: Assuming the goal is to reach zero net-energy by some future date, and that electricity will still be needed for lights and other end-use loads, does it make sense to require installation of renewable energy systems that generate electricity as opposed to systems that meet thermal loads?

The renewable systems used to provide thermal loads can be more cost effective compared to renewable power systems, especially when considering passive systems. For instance, the additional cost of trombe walls could be significantly lower than the price of a renewable system (eg: photovoltaic system) that provides the electricity demand. The price reduction of renewable power systems would make the installation of such systems more feasible.

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EmiratesGBC Technical Workshop #2016-3:

REGENERATIVE AND RESILIENT URBANISM

Demonstrating how sustainable urban design costs less than business-as-usual

February 17, 2016

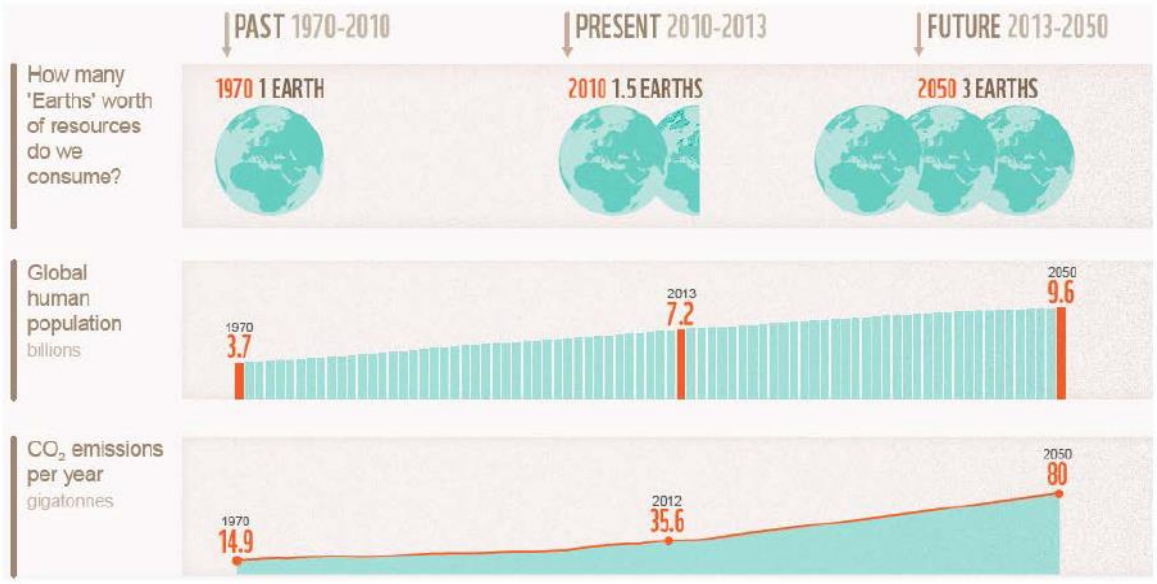
Introduction

Traditionally, urban design has been practiced as an extension of architecture, urban planning, and civil engineering. The concept of resilience and its relation to sustainability has been recently addressed. City planners, government officials, natural resource managers, researchers, and practitioners are working on shaping its definition.

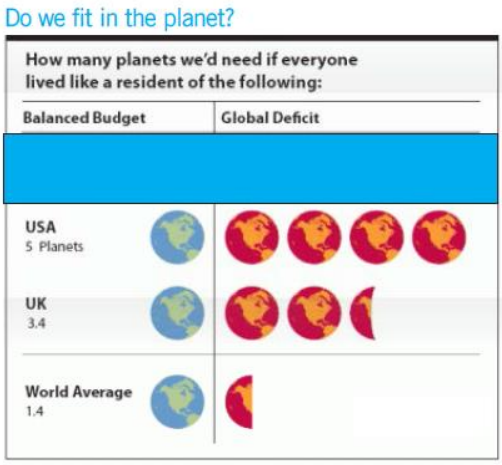
On February 17th 2016, the EmiratesGBC Technical Workshop has been held at the offices of EmiratesGBC's Corporate Member Perkins & Will to discuss the theory of resilience and the increasing need for it in the Arab world. Facilitators discussed case studies from a series of real world LEED, BREAM and ESTIDAMA projects where resilient urbanism approaches were demonstrated to create significant capital cost reductions.

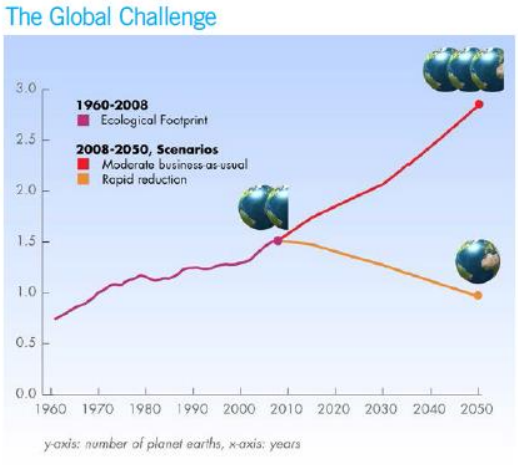
Why is Sustainability Important?

Our planet is running out of room and resources. Adding population growth to that, we'll see that the Earth cannot provide enough resources for all of us in the long term. We will need "3 Earths" of resources by 2050 if we continue exploiting our natural resources at the current rate. This is because of the current pattern of economic growth which is environmentally unsustainable.



The graph below shows the trajectory of the global ecological footprint if we continue to consume at current levels in comparison to a rapid reduction of footprint to the One Planet level in 2050.





Sustainability is scientifically defined as a dynamic state in which global ecological and social systems are not systematically undermined. Ensuring that activities do not systematically undermine ecological and social systems is to ensure that the capacity of future generations to meet their needs is not compromised.

UAE Targets

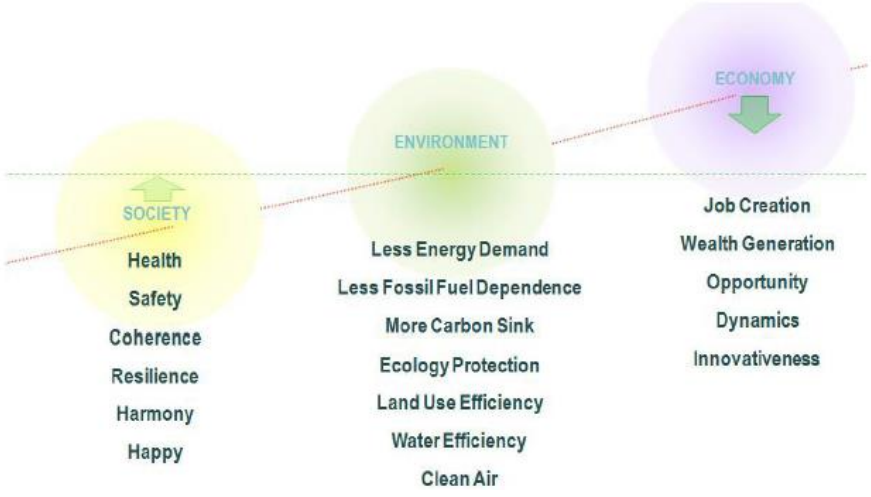
Beside improving the overall infrastructure of the country, the UAE Vision 2021 agenda has also set targets to raise the air quality index to 90%; increase the share of clean technologies to 24%, and the percentage of treated wastes to 75% by year 2021.

On an Emirate level:

- Dubai aims to achieve a 29% clean energy share in the total fuel mix by 2030 and targets to reduce the energy and water consumption by 30% by 2030.
- Abu Dhabi plans to increase the share of nuclear and renewable energy in the electricity production to 25% and 7% respectively by year 2020.

Objectives of Low Carbon Cities

A sustainable city, or eco-city is a city designed with special consideration on its environmental impact. It looks at the minimization of required inputs of energy, water and food, and the reduction of outputs of wastes and CO2 emissions. A sustainable city looks at the triple bottom line which consists of social equity, economic, and environmental factors.



Sustainability Initiatives and Assessment Tools

There are several energy assessment tools that are used to rate buildings, such as: Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), Green Star, Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)… In the UAE, new buildings must comply with the Green

Building Regulations and Specifications in Dubai and with the minimum requirements under the Estidama Pearl Rating System in Abu Dhabi.

Resilience

Urban Resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.

Design, resilience and sustainability are linked and can play a powerful role in the adaptation and mitigation of climate change.

Chronic Stresses

- Chronic Stresses are stresses that weaken the fabric of a city on a daily or cyclical basis.
- Examples on chronic stresses include:
- High unemployment
- Overtaxed or inefficient public transportation system
- Endemic violence
- Chronic food and water shortages.

Acute Shocks

Acute shocks are sudden, sharp events that threaten a city.

Examples on acute shocks include:

- Earthquakes
- Floods
- Disease outbreaks
- Terrorist attacks

- Infrastructure failure

Examples of City Failure

- Floods - New Orleans

- Hurricane Sandy - Lower Manhattan

- Drought and Wildfires – Californian

- Earthquake – Nepal

RELi Standard

RELi Standard integrates a comprehensive listing of resilient design criteria with the latest proven integrative process measures for developing next generation communities, neighbourhoods, buildings, homes and infrastructure. It is similar to LEED® with a lens on resiliency.

It is a simple and comprehensive “to-do” list. RELis requisites and credits can be viewed as patterns forming a web of interconnected relationships with emergent, intangible properties. For ease of use, RELi is structured much like LEED® and other point based rating systems.

For teams seeking to explore advanced resiliency, RELi can be a great starting point for many regenerative, restorative and sustainable designs.

Project Example: The Big “U”

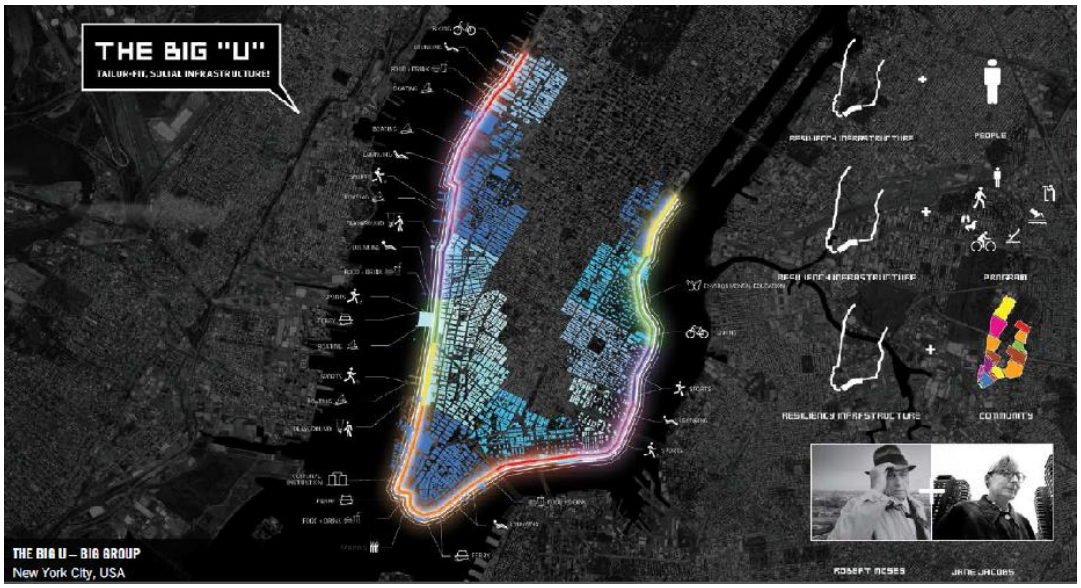
The Big U is a protective system around Manhattan, driven by the needs and concerns of its communities. Stretching from West 57th street south to The Battery and up to East 42th street, the Big U protects 10 continuous miles of low-lying geography that comprise an incredibly dense, vibrant, and vulnerable urban area. The proposed system not only shields the city against floods and storm water; it provides social and environmental benefits to the community, and an improved public realm.

The proposal consists of separate but coordinated plans for three contiguous regions of the waterfront and associated communities, regions dubbed compartments. Each compartment comprises a physically separate flood-protection zone, isolated from flooding in the other zones, but each equally a field for integrated social and community planning.

Bridging Berm provides robust vertical protection for the Lower East Side from future storm surge and rising sea levels. The Berm also offers pleasant, accessible routes into the park, with many un-programmed spots for resting, socializing, and enjoying views of the park and river.

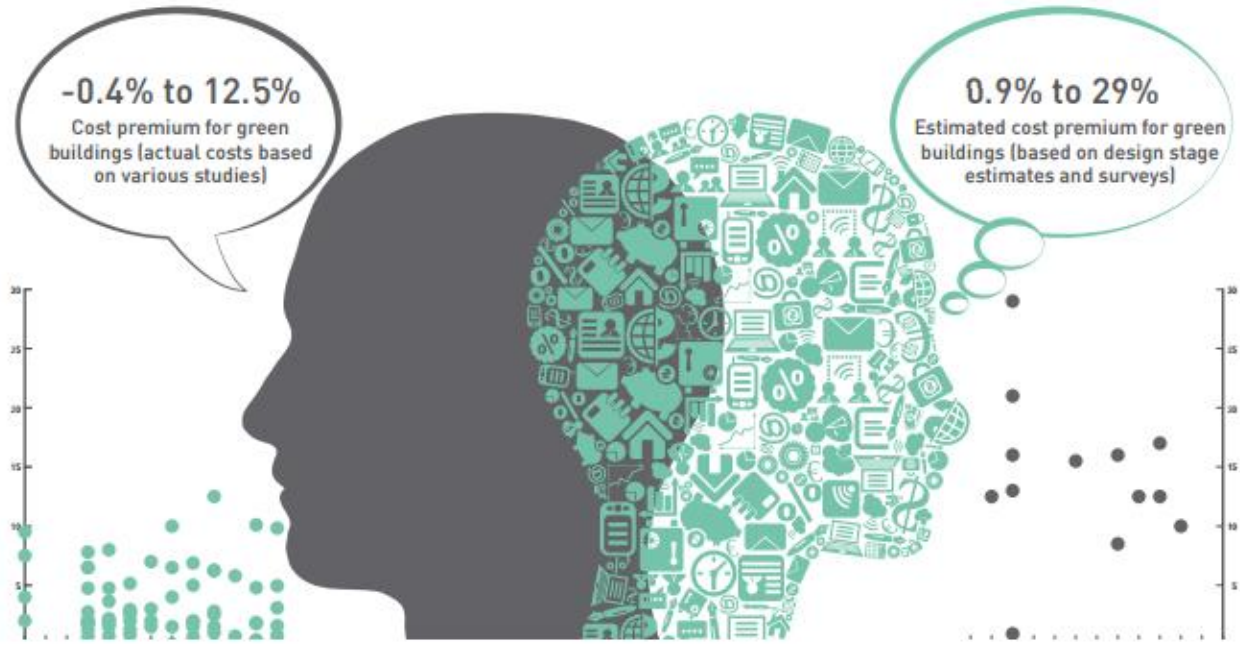
Between the Manhattan Bridge and Montgomery Street, deployable walls are attached to the underside of the FDR Drive, ready to flip down to prepare for flood events. Decorated by neighbourhood artists, the panels when not in use create an inviting ceiling above the East River Esplanade. At night, lighting integrated into the panels transforms a currently menacing area into a safe destination.

The east and west boundaries of the Battery were key inlets during Hurricane Sandy, allowing floodwaters to rush into Lower Manhattan and shut down the nation's – and the world's – premier financial district. Enhancing the public realm while protecting the Financial District and critical transportation infrastructure beyond, the Battery Berm weaves an elevated path through the park. Along this berm, a series of upland knolls form unique landscapes where people farm, sunbathe, eat and engage with world class gardens.

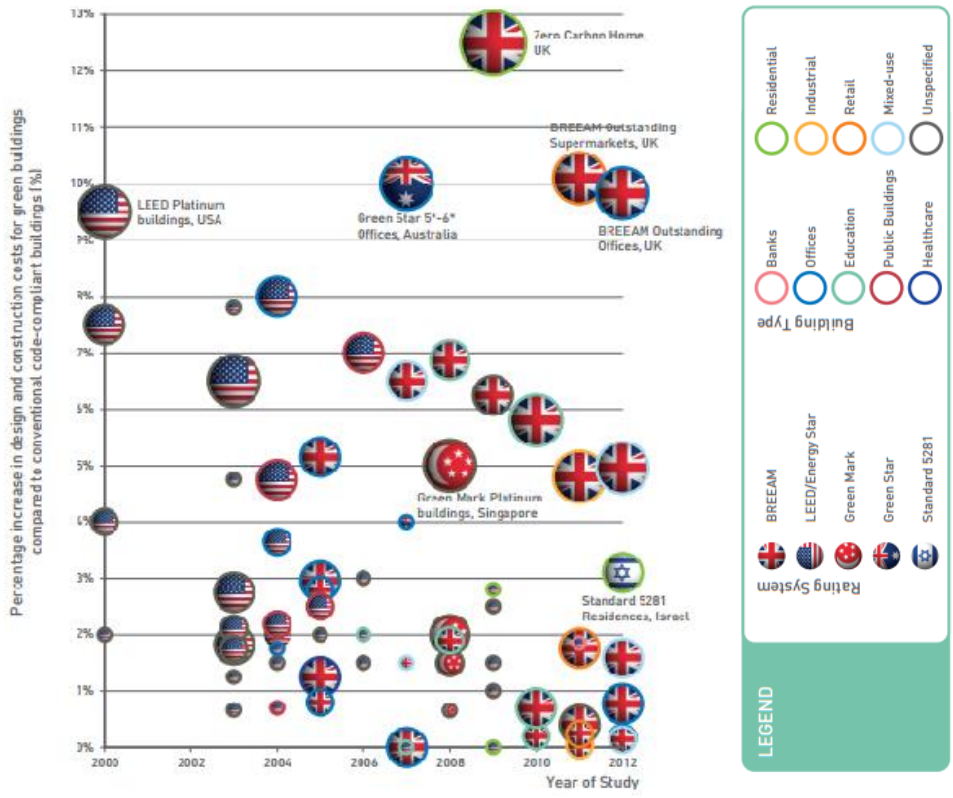


Sustainable Design Cost Misconceptions

The challenge for design teams is often to deliver green buildings within conventional budgets. However, meeting this challenge is made more difficult because there are many industry professionals who operate under the general assumption that building green increases design and construction cost by approximately 10-20% (with estimates as high as 29%) compared to the cost of conventional code compliant buildings.



The figure below shows the distribution of actual design and construction costs in various countries There is clearly a perception gap here that needs to be addressed.



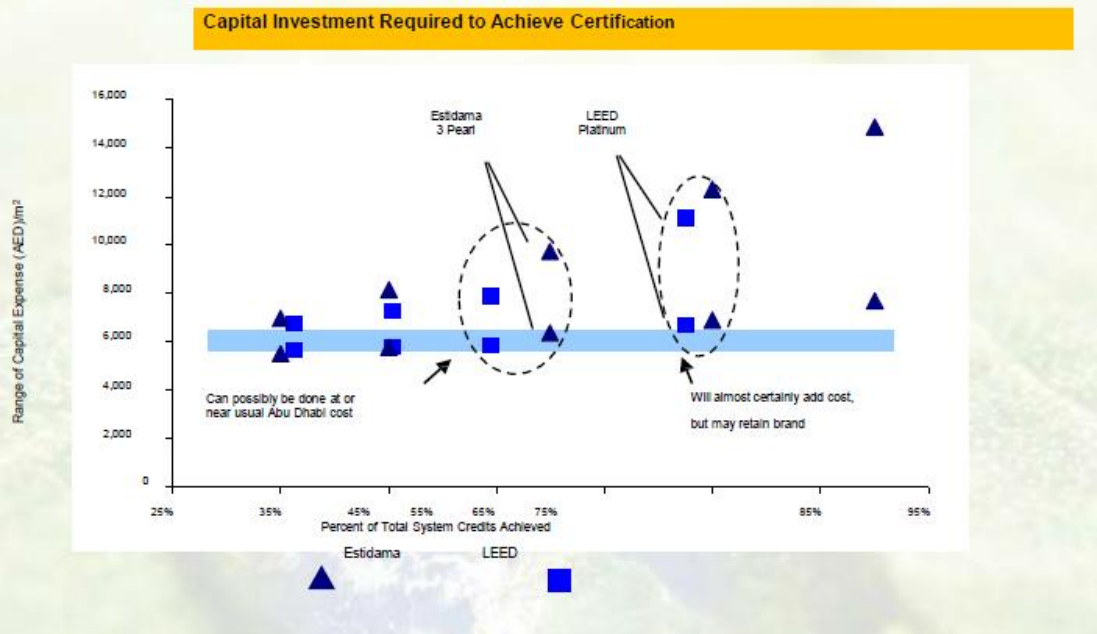
LEED

LEED Certified, Silver & Gold Rating can be achieved with no or minimal additional costs usually estimated at 0-3% of the initial cost. In Oregon, a middle school obtained LEED Gold Rating with no additional costs. The school design was designed to achieve 60% reduction in energy consumption.

Cost of other Rating Systems

The figure below shows that increases in upfront cost have been found to be proportional to the increased level of environmental certification, with more aspirational projects, such as those that aim for ‘zero carbon’ performance, showing a 12.5% increase in design and construction cost compared to a conventional building. But for the majority of certified green buildings, the cost typically ranges from less than 0% to 4%, based on studies published within the last ten years. Higher levels of certification (such as BREEAM Very Good, LEED Silver/Gold, and Green Mark Gold/Gold Plus) have been shown to range from 0% to 10%, while the highest levels (such as BREEAM Excellent, LEED Platinum, Green Mark Platinum and ‘zero carbon’ in the range of 2% to 12.5% higher costs.

LEED VS Estidama



Case Study: Qatar Science and Technology Park

The vision of the Qatar Science and Technology Park masterplan is to create both a physical and virtual hub for the knowledge economy in Qatar. The masterplan encompasses 123 ha of land which is integrated with the facilities of the Qatar Foundation, its new teaching hospital and the new convention centre.

Phase one construction of the park, comprises 115,000 sqm of development. At its heart is the 12,000 sqm Incubator Centre (IC), incorporating the administrative hub and business centre. This building is flanked by the first tow tenant laboratory Information Transfer Centre (ITTC) buildings, each 20,000 sqm.

Project Description and Requirements

- Commitment to LEED Gold standards
- No connection to mains sewer
- Insufficient Storm Water Network
- Commitment to highlighting smart design
- Masterplan based on a Central Park requiring extensive landscaping
- Walkable network of streets and mesh based on pedestrian movement

Proposed/Implemented Measures

- Using On-Site Wastewater Treatment through Reed Beds which also acted as storm water storage
- Provision of agricultural crop growth areas in park
- Replacing landscape space with green infrastructure
- Incorporation of solar PV over reed beds

Reed Bed Wastewater System

- Need to examine the totality of the infrastructure
- Reed beds have higher capital costs than STP
- Cost of building pipelines and operation are major differentiators
- Reed beds replace landscape area reducing landscape construction cost by 90 million riyals

EPIC Irrigation System

- EPIC system is more expensive than traditional
- Cost of building tanks and pumps makes a difference
- System also acts as storm water network reducing construction cost by QAR 36,000,000
- O&M costs reduced by QAR 70,000,000
- Water consumption 80% reduced

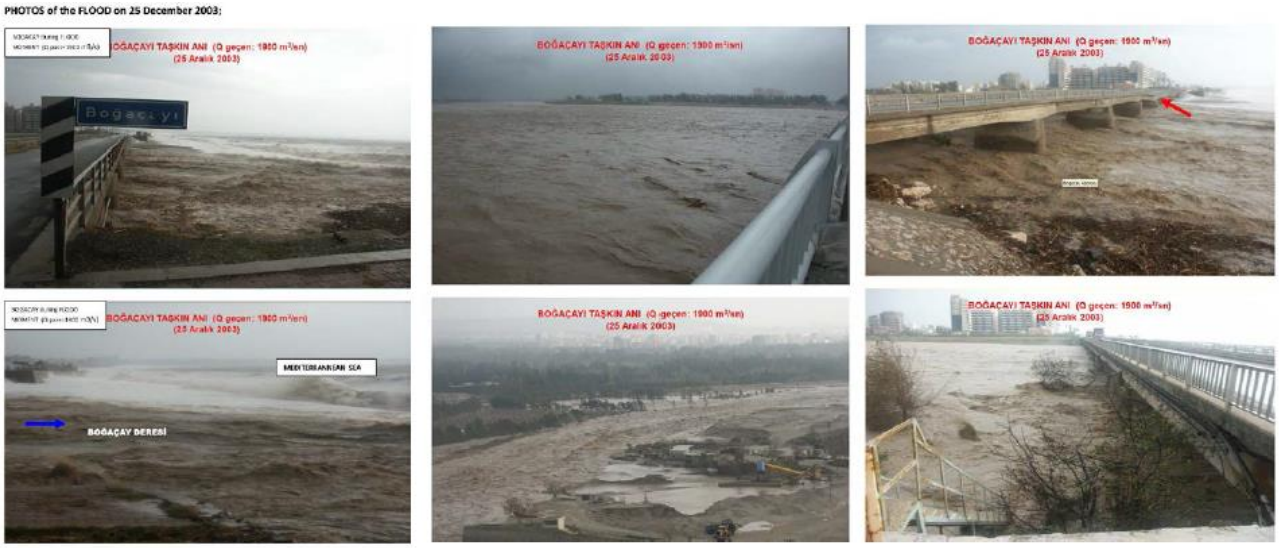
Key learning points

- Both systems greatly improve resilience by resolving infrastructure issues on-site
- Both systems use tested and proven technology that works in the region

Project Discussion: Bogacay Creek, Antalya Turkey

Objective

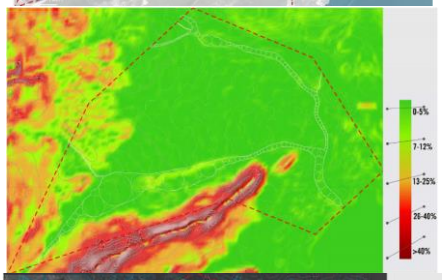
Development of a marina at the Bogacay Creek in Antalya, Turkey which is flood prone area.



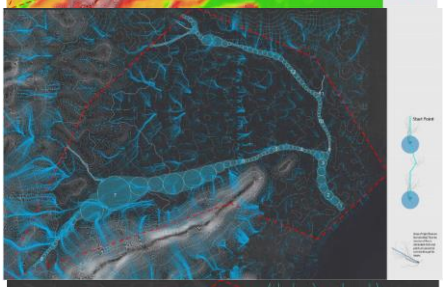
Approach

- Mapping

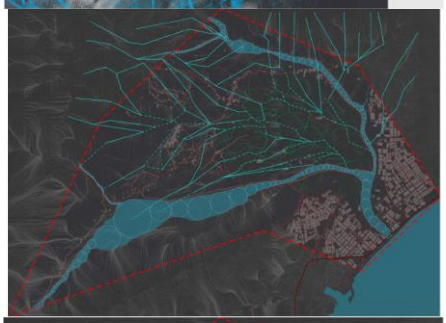
- Indexing Ground Levels



- Indexing Water Flow

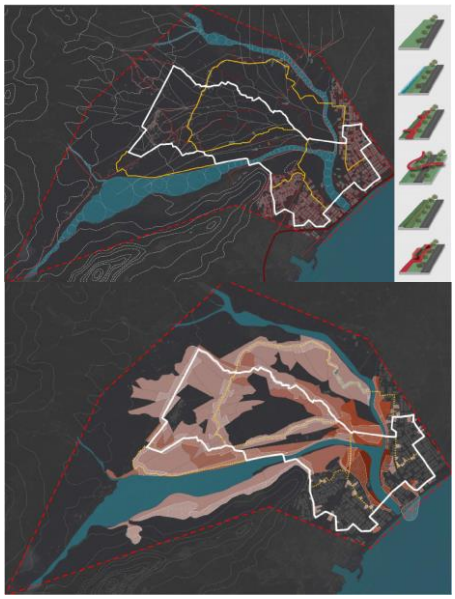


- Indexing Water Flow from Fields



- Urban Connectivity

- Creating Public Loop



- Identifying Site Parcels

Q&A

The use of gray water in Dubai

Dubai is allowing the treatment of gray water.

The position of residents in regards to the Bogacay Creek project

Residents want the project to be implemented and are looking forward to solve the flood problem.

The uses of the new developments of the Bogacay Creek project.

The main design was focused on creating connections and tourism activities.

Reduction of energy consumption of buildings

Energy modeling is used to specify the passive heating and cooling strategies that reduce the energy demand. After reducing the energy demand, selection of energy efficient equipment is also important.

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- C3 Living Design. Resiliency Action List and Credit Catalogue, 2015.
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EmiratesGBC Technical Workshop #2016-4:

INTERNAL COMFORT Best Practices in Ventilation Design

March 08, 2016

Introduction

High ambient temperatures in Dubai means huge volumes of cooled air must be efficiently distributed inside shopping malls, cinemas, airports and hospitals. One of the challenges in HVAC design for these large indoor spaces is how to distribute the huge air volume without causing drafts and high noise levels but allowing for the effective mixing of air.

On March 8th, 2016, EmiratesGBC welcomed a large audience of industry members and partners to its Technical Workshop to discuss different ventilation techniques and their assisting technologies and how these methods are used in practice in the Middle East to maintain a high standard of internal comfort. Participants also discussed how airflow products are selected for different internal environments.

What is Internal Comfort?

The determining factors that induce or disrupt internal comfort are:

- Light
- **Noise**
- Color
- Emotional State
- Thermal Comfort
- **Air Quality**
- **Air Velocity (draft)**

To stay on topic, the facilitators decided to focus on the topics highlighted in bold as they are more closely related to ventilation

Thermal Comfort

Thermal comfort is extensively studied by the HVAC industry. The Predicted Mean Vote (PMV) is used by certain manufacturers to determine the comfort level. At 23 degrees C and with 50% relative humidity, studies show that at least 5% of indoor occupants will always complain about the IAQ.

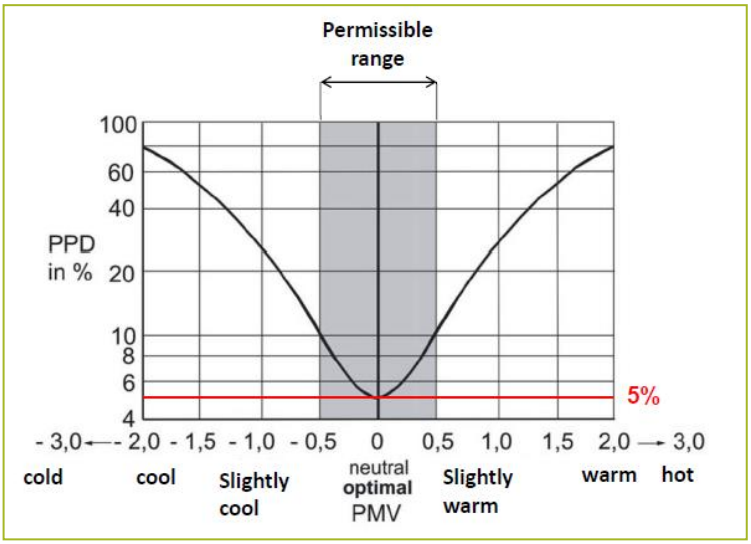


Figure 1 Predicted Mean Vote (PMV) and predicted percentage of dissatisfied PPD (thermal condition of the body

The PMV depends on 2 factors:

- Clothing – the main way people regulate their body temperature is by what they wear. Amount of clothing and type of clothing vary on external conditions but most people dress to suit outdoor temperature.

- Metabolic Rate (Activity Level) – is the amount of heat given off by the human body and varies on the work rate or Metabolic Rate (met). A body at rest will tolerate a higher temperature than a body at work.

Air Temperature

To maintain thermal comfort for occupants within a given environment, it is important to maintain the room temperature within set limits. The limit deemed acceptable for a given environment is a function of the different activity levels among the occupants. See Figure 2.

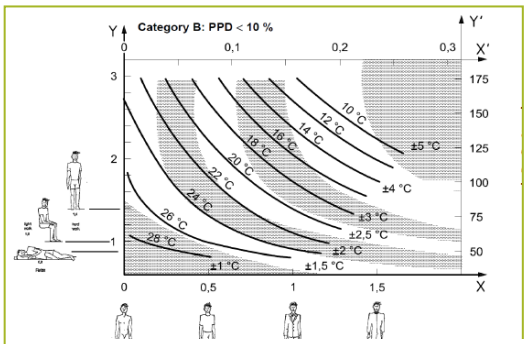


Figure 2 the graph plots acceptable comfort conditions for occupants based on the Met and clothing rate values

Air Temperature Gradient

In addition to the average air temperature within the room, it is important to control temperature gradients within acceptable levels. A high temperature differential between the head of an occupant and the ankles can cause a lot of discomfort. This can be more apparently felt when the ventilation system is in heating mode due to the increased sensitivity of bodies to the increased in temperature.

Draft Risk

Definition: The predicted percentage of people that will feel uncomfortable due to indoor drafts. Indoor draft risk depends on:

- Air temperature
- Average airflow velocity
- Level of turbulence (fluctuation of air velocity depending on the ventilation system)

Noise – Acoustics

In acoustics the variables that are studied and regulated are:

- Sound Pressure: Human hearing can withstand a large range of sound pressure. Normal hearing threshold level is = 20 μPa and the threshold for pain is = 1,000,000,000 μPa
- Decibel levels: Indicates the sound level. Hearing threshold is = 0 dB. The threshold of pain is = 130 dB.

Indoor Air Quality

A room's air quality is determined by all the non-thermal effects inside room air that usually affect people's health and well-being. The essential requirements for good indoor air quality are that 1) the air contains no contaminants in hazardous concentrations, and 2) the air is not perceived as smelly or stale.

Ventilation Systems & Techniques

The final stage of maintaining comfortable internal comfort levels is determining the right air distribution systems. This procedure looks at two main criteria:

1. The type of air discharge that the indoor space needs
2. The kind of air distribution systems that can possibly be installed

Air that is supplied inside a building through its HVAC system exits a vent through a diffuser outlet. Selecting the right diffuser makes all the difference. There are different types of air distribution systems/diffusers:

- Turbulent System – typically installed on ceilings
    - Integrate into various ceiling systems
    - Provide maximum air change rate
    - Higher induction – better efficiency
    - Stronger mixture with room
    - Range of discharge velocity in supply air between 2 and 5m/s
    - Less cold and hot spots

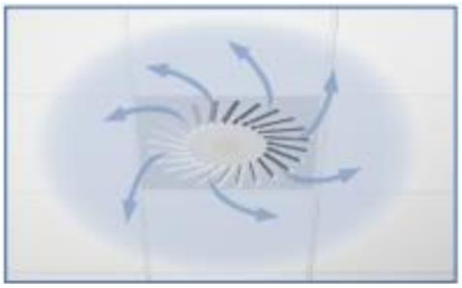


Figure 3 Turbulent air diffuser

Turbulent diffusers help by reducing the velocity of the air and its temperature before it reaches people. Meanwhile air and heat coming off indoor occupants (room air) also rises up and is taken in to the return system.

- Displacement Systems – more frequently used in movie theatres, museums and other public places with high ceilings where cooling is not required near the ceiling. They are installed into walls and emit air at very low velocity: 0.3 m/s is typically the maximum velocity and the temperature range typically varies between 18 and 22 C. Other features of the distribution system:
    - Lower induction
    - Supply air mixes less easily with room air- better for IAQ
    - Air is discharged across a large area
    - Low turbulence supply air discharge
    - Different designs available to fit different interiors

Figure 4 Distribution System

Airflow Design

The selection of the right diffusers is very dependent on set points. HVAC installation entails measuring the distance between the diffusers, the distance between diffuser and wall and the height of the diffuser. The standard height of a person is taken at 1.8m. These points influence how the air travels down, and hits the wall. Acceptable velocity is 0.25 – 0.3 m/s in order to reach comfort level and a temperature of not more 21C or 22C. High velocity means the air reaching people is at a colder temperature and that means it's uncomfortable.

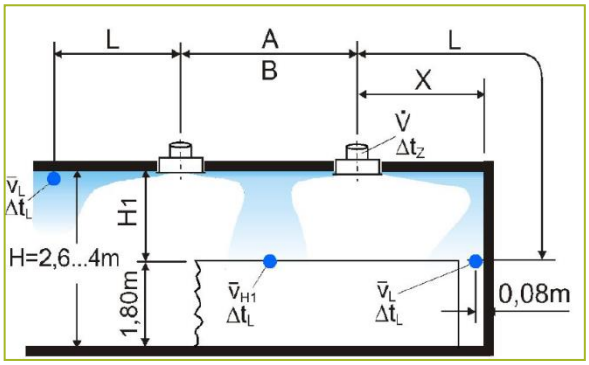


Figure 5 Example of the measuring points calculations taken to determine optimal diffuser location

Room Air Velocity

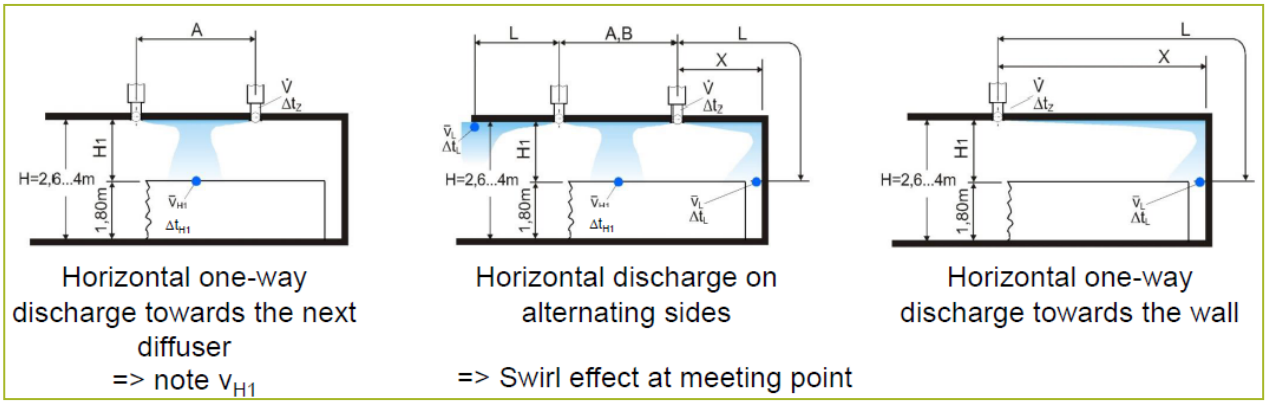


Figure 6 The different diffuser location set points and how their direction, air velocity and temperature is calculated for optimum efficiency

Product Selector

Slot Diffusers – Slot diffusers, especially linear slot diffusers are very popular, but a drawback to using them is that they don't handle too much air. Slot diffusers are more needed in rooms where there is a high need for internal comfort such as offices or meeting rooms. Features typical to slot diffusers include:

- Mixed flow ventilation
- Variable and constant volume flows

Typically occurring issues with slot diffusers are that they are usually under-designed which requires them to work at higher speeds, which leads to increased noise levels. In general, the optimum height limit for speed diffusers is around 5m beyond which their efficacy can be compromised.

Jet Nozzles – Are typically used in larger interior spaces such as hotels and airports. Key characteristics of jet nozzles are that they:

- Provide a long throw distance
- Can be adjustable (either manually or electrically)

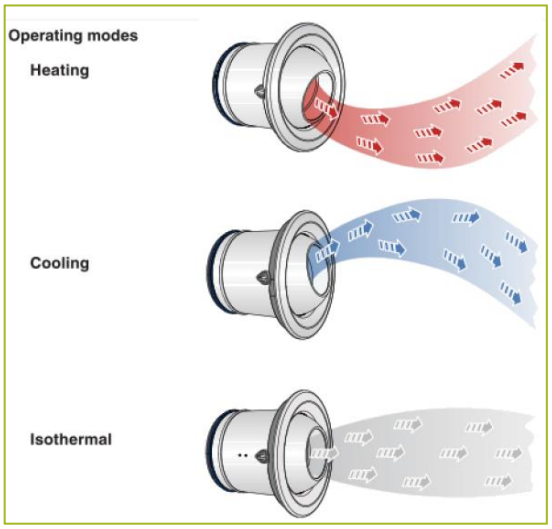


Figure 7 Jet Nozzle directions

Jet Nozzle Areas of Application:

- Halls, airports, railway stations
- Mixed flow ventilation
- Variable and constant flow volumes

It is critical to choose jet nozzles carefully as they can throw a large amount of air in a large area - range can sometimes be 5 m/s – based on the temperature needed, the velocity of the HVAC system, and the occupancy needs, the nozzle can be turned upward or downward. Selecting the angle is very important.

Another important installation feature of the jet nozzles which has to be factored in during the design process is to have nozzles facing each other so that the air can collide and the velocity is reduced.

Some manufacturers also provide individual plate designs which have functional as well as aesthetic applications. Swirl plates can be integrated into various ceiling systems. They have the advantage of reducing airflow velocities and temperature differences and can also hide the swirl unit if it's not desired to be seen.

Swirl Diffusers

Advantages of swirl diffusers are that they can help to reduce the air velocity and increase occupant comfort. They can also reduce or eliminate noise from air units. It is extremely important again to measure the distance between the walls and test the velocity of the system before finalizing installation. Some participants mentioned that in their experience, they have not seen contractors measuring nor designers specifying the crucial distance needed between the floors and ceiling, between swirl diffusers and between swirl diffusers and interior walls.

Figure 8 Sample swirl diffuser element set up including the plenum, damper and face element.

Floor Diffusers – have similar application as displacement diffusers, and there are temperature requirements too: 18C to 22C. Face velocity should not be more than 1.5 m/s. Again distance from people is a critical matter – floor diffusers should not be installed near people. Two discharge methods used are shown in Figure 8 below: the horizontal and the vertical discharge. A dirt trap is important and should be included. Again, set point measures are important. Floor diffusers are common in theaters.

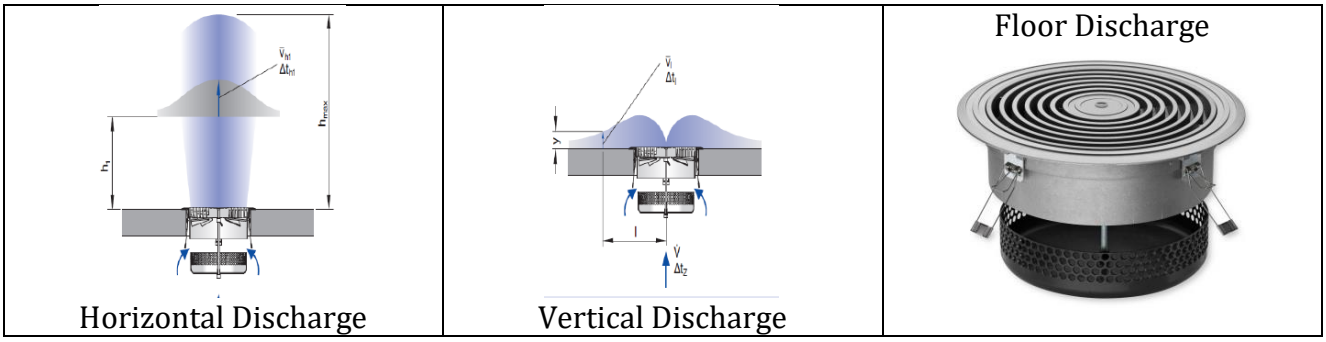


Figure 9 Examples of different discharge methods in floor diffusers

Product Selector Tool

Workshop facilitators led participants through a product selector tool which eliminates the hassle of calculations by allowing users to specify all the parameters mentioned earlier which encompass the measuring set points, distance, temperature, velocity etc and the tool also specifies which product is most ideal for that situation.

The tool can be accessed here:
http://www.trox.ae/downloads/58263629687ec011/TROX_EPF_2.3.5.0_Setup.exe

EmiratesGBC Technical Workshop #2016-5:

Expanded Polystyrene (EPS) in Geotechnical Applications

May 16, 2016

Introduction

To complement EmiratesGBC workshops which cover topics related to design and building systems, some sessions address the technical and environmental characteristics of materials and technologies which contribute to greening the built environment.

On May 16th, EmiratesGBC hosted a workshop on the various usage of Expanded Polystyrene (EPS) insulation in the building and construction industries. Discussions looked at the various applications of the material, its compliance against flammability regulations in the UAE, and safety precautions related to the installation and maintenance of the product.

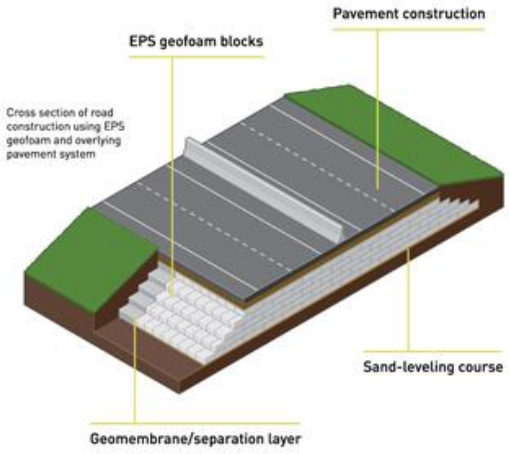
Technical characteristics

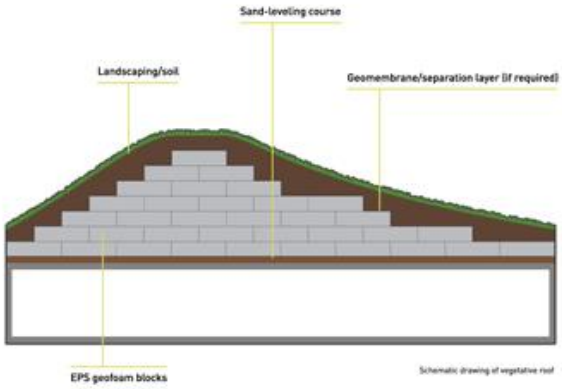
Expanded polystyrene (EPS) geofoam is an engineered foam polymer which has been used as a geotechnical material since the 1960s. Its key characteristics make it an interesting alternative to standard earth fill material, including amongst others:

- Production of EPS geofoam is easy and quick, and the final product to be used onsite can be shaped according to specific needs and upon request. It can therefore help reduce the overall project timeframe and therefore reduce the project's costs.
- Its light weight facilitates its transportation from the manufacture to project site and its usage. It can for instance eliminate the need for heavy utility relocation and handling equipment.
- EPS geofoam can be produced in a range of compressive resistances relevant to a specific project in order to support the design loading while minimizing cost. The type and strength will depend on the final application of the product.

Thanks to the above-mentioned advantages, it is a material worth considering for the following applications:

- Transportation: Road construction, road widening, Bridge abutment and underfill, slope stabilization, airport runway and taxiway, rail embankment, culverts and pipelines, levees…;
- Building construction support: Compensating foundations for building settlements, insulation, landscaping and vegetative roofs, retaining/buried wall backfill, stadium and theatre seating;
- Other special applications such as seismic design, noise and vibration damping, rockfall and impact protection.





In terms of the product's behaviors and project risk management, fire safety, impacts exposure to chemicals, UV lights and water were presented:

- EPS geofoam is manufactured with a flame retardant which inhibits the early stages of fire development. It is combustible but it is a self-extinguishing material. Precautions need to be implemented particularly during its usage and installation, especially during fire-related procedures such as welding.
- Exposure to chemicals: the following table compiles the list of chemicals that could damage the product and therefore negatively impact the final applications:

EPS is resistant to:	Chemicals that may damage EPS:	
• alkalis	• hydrocarbons	• concentrated acids
• dilute inorganic acids	• chlorinated hydrocarbons	• vegetable oils
• gypsum plaster	• organic solvents	• paraffin
• most alcohols	• ketones	• animal fats and oils
• portland cement	• ethers	
• silicone oil	• esters	
• solvent-free bitumen	• diesel and gasoline	

This table provides general guidance but should not be relied upon solely when EPS geofoam could be exposed to chemicals.

- If left outdoors and exposed to sunlight for long periods of time, minor degradation can occur without causing detrimental property changes of practical importance. The product's discoloring can however be removed by power washing or a grinder, if desired.
- The product has a closed-cell structure that limits water absorption. When used in well-drained conditions, no change in EPS geofoam weight is expected over time unless if installed in a submerged application.

Sustainability characteristics

Following the description of the main criteria and applications of EPS geofoam for buildings and road infrastructures, the workshop participants were informed about how its production and usage have a limited impact on the environment:

- Manufacture: Standard soil fills are constructed in thin lifts with repeated compaction. This requires considerable time, construction equipment, fuel to operate the equipment and testing to ensure adequate compaction. The production of geofoam also prevents the moving and re-shuffling of soils and therefore the direct impacts over biodiversity.
- Site transportation: Compared with traditional fill materials, fewer trucks with lighter loads are required to deliver EPS geofoam to a project site. This means less pollution from fuel emissions and less pressure over the roads and other public infrastructures.
- Recycling: Based on the final application EPS geofoam can be reground, recycled and reused in many composite applications such as lightweight concrete, plastic lumber, weather resistant outdoor decks, fencing…Due to quality issues of the re-processed

product around 5% cannot be introduced back in the manufacturing process and will therefore be diverted and melted back into hard plastic.

Responding to these points, the participants discussed the overall need to educate the market and highlight the advantages of latest construction materials:

- Educating the designers, consultants and contractors on availability and affordability of green materials and on its various applications;
- Training onsite professionals to properly install the product as per the project's requirements and preventing exposure to the above-mentioned items that could affect its performance;

Stricter disclosure and understanding of life-cycle assessment information should be made mandatory within tender processes in order to make waste management an intrinsic factor for decision-making. At last the participants have discussed the need for clearer fire codes from the authorities in order to ensure that all materials used especially for building applications comply with the highest safety standards.

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- Geofoam.org, details on characteristics and applications of expanded polystyrene and geofoam.
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EmiratesGBC Technical Workshop #2016-6:

Sustainable Building Materials in the Gulf

July 19, 2016

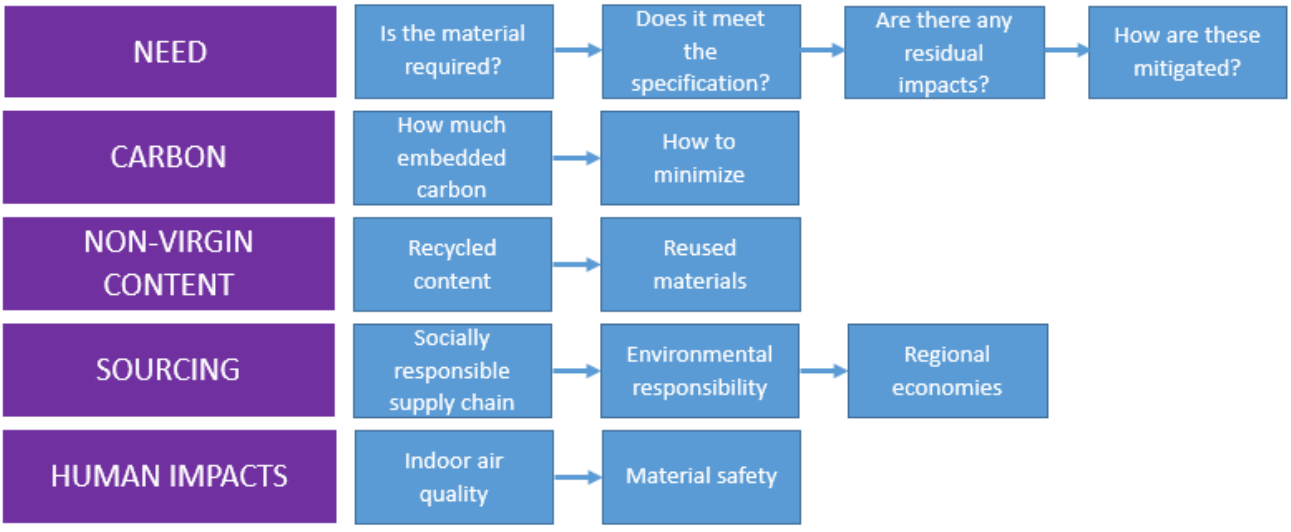
Introduction

Recently, there has been a lot of concerted focus on the adoption of green construction materials and products which decrease the use of natural resources and increase the reusability of materials. The increasing aim is to raise the bar on the sustainable procurement of building materials. However, there are challenges to this goal and industry stakeholders are most attuned to what these are as eliminating the problems require substantial changes in a company's business model.

Hence, on July 19th, EmiratesGBC hosted a workshop on sustainable construction materials where participants were invited to share their experience on what is available in the UAE market, what roadblocks are faced by suppliers and the supply chain, and what the future holds.

Roadblocks typically considered involved: supplier awareness of requirements and ability to provide required documentation such as EPDs; pricing, regulatory or legislative problems, and availability of materials.

What are Sustainability Considerations?



The question of what sustainability is all about is paramount to understanding the steps that need to be taken. The following figure explains the backbone of responsible sourcing – i.e., the key categories that all considerations stem from. It is essential to use guides such as the skeleton below to understand what are the right questions to ask when considering the impact and importance of sustainable decision making.

Responsible Sourcing

In the UAE and GCC region, certain building materials are used extensively and also generate a proportionally large environmental impact. These are: concrete, steel, PVC, aggregate, and timber. The responsible sourcing for most of these popular and critical materials is globally targeted by the following international standards and certifications:

- ISO 9001
- ISO 26000
- OHAS 18001
- ISO 14001/EMAS (over 250 employers)
- BS 8555 (less than 250 employers)
- SA 8000

Figure 10. Decision making guide for the sustainable sourcing of building materials

The question of whether these certifications are readily available in the supply chain was addressed at the workshop. The consensus was that with some products, such as concrete and steel, certifications are commonly available, and oftentimes, it is the large scale supplier/vendor who are typically able to provide evidence of conformity in a cost effective manner. With other products such as aggregate and PVC, obtaining certified products usually entails a large price premium.

For a few contractors, it is becoming commonplace to audit the supply chain of certain products and ensure the supply chain is clear.

Steel

Sustainable steel sources include:

- GWP equal or lower to the World Steel average using EPDs (EN 15804)
- CARES Sustainability standard, BES 6001
- World Steel Association Climate Action Programme

Workshop participants brought up the legislative aspect as sometimes less helpful in bringing conformity to the table; for example, a government circular specifying use of local materials only when they are not as sustainable does not help much. The consensus was that it's easier to find recycled content in reinforcement steel than in structural steel, and certain countries manufacture steel with more recycled content but it can be prohibitive to use due to certain legislative rules.

With the maturity of the construction market in the UAE, one participant felt that there may be enough recycled content available in the market to produce recycled steel locally, but it's not currently in practice.

When it comes to steel, with the requirement of EPDs in effect, local consultants are noticing a difficulty in rating system compliance simply because supplies are unavailable to provide necessary EPDs. For e.g. LEED v4 has been in effect since 2013, and it was updated to drive the EPD market, however there have been no v4 projects that have been approved in the UAE, yet LEED v4 will become mandatory as of October 2016.

PVC

Polyvinyl Chloride (PVC) typically has a smaller footprint than any other material from the production point of view. Different authorities and companies in the UAE have different requirements for PVC handling. Some have take-back schemes. Some contractors push practices where they make suppliers take back packaging material to prevent it from ending up in the landfill. Some reuse PVC 'plywood' frequently, and although this should be a common procedure it isn't always the case. With the impending increase in tipping fees, this might become common practice.

- Manufacture in accordance with ECVM industry Charter
- Manufacturing minimum requirements:
  - Water emissions in line with local water quality requirements
  - Gaseous emissions below EU standards
  - Fugitive emissions prevented
  - No lead, mercury, or cadmium stabilizers
  - Non-phthalate plasticizers only
  - 30% recycled content encourages

- Supply and disposal minimum requirements

Concrete

Concrete production is universally recognized as a very carbon intensive process. There are a whole range of products that can be used instead of cement, such as rice husk, fly ash or Ground Granulated Blast Furnace Slag (GGBS). GGBS and micro silica as mixtures are more commonly found in the UAE cement market. A Dubai Municipality circular is clear on the limit of cement (60-70%) that can be used and many manufacturers are compliant by providing less environmentally impactful cement mixes. However, this percentage could be increased further.

The more recycled content in concrete the longer the curing time which adds to the total cost. The question of working with concrete suppliers was posed and it turns out that as most specifications are led by clients in terms of cost limitations, this sometimes precludes the decision making ability of designers and engineers to specify more environmentally friendly yet structurally sound concrete mixes.

The consensus among participants held that working with the supplier and proposing solutions to them is the best way to achieve low cement use.

GWP (kgCO2/m3) limited to:

Strength Grade	20MPa and lower	30MPa	40MPa	50MPa and greater
Concrete Supply	215	250	270	280

Timber

FSC certified timber is a material that is harvested from responsibly managed forests. The argument posed at the Workshop was why timber use has to be 50% FSC certified for any particular project. Another point noted was that most of the timber used in the UAE comes from critically endangered species. It is strongly recommended to use FSC or PEFC for all timber, including temporary works. While FSC is available in the market, it is certainly cost-prohibitive. Real price examples that were shared:

- 1 FSC certified plywood sheet = 135 AED
- 1 non FSC plywood sheet = 75 AED

DBGR&S regulates that 25% of timber used should be FSC certified, which the consensus held as a low threshold. Hence, it is up to owners and designers to make subcontractors raise their

target. At the moment the FSC only goal isn't practiced by many contractors in the UAE. Moreover, the break in the FSC Chain of Custody (COC) is also an issue which companies are aware of but are incapable of trying to overcome completely. A few timber subcontractors will provide the full COC but after a few years the certification has become old and this can impact a buildings green rating.

In order to maintain green certification credit, auditing does help and it works best when it is an integrated approach. Awareness among all stakeholders is oftentimes the best way to shift change towards more robust and verifiable COCs.

- Suggested timbers to avoid:
    - Meranti
    - Rosewood
    - Any other endangered species
    - Chromated copper arsenate-treated timbers

Aggregate

Crushed Concrete Aggregate (CCA) as the name suggests is recycled concrete crushed into smaller pieces of a specified size and quality and is reused again in the construction of new buildings. Crushing concrete waste onsite is a cost-effective way to recycle the material and results in a good building material. It also has less impact on the environment than virgin aggregate and is popular due to the green certification credits its procurement and use can bring in.

However, there are questions and concerns as to the efficacy and safety of using construction demotion waste in the UAE which warrants further study, for e.g., there can be instances of asbestos contamination in the material. The consensus among participants is that its best if used for temporary use and/or for landscaping.

The different kinds of CCA cases uses and their sustainability threshold:

- Road Base/unbound mixtures
    - Up to 90% CCA
- Must comply with AASHTO M 319-02 / BS EN 13403
    - Pavement surface
    - Up to 15% CCA

- Concrete production
  - Up to 15% CCA provided CCA is produced at the batching plant or from unused concrete
  - Not imported CCA
  - Must comply with BS 8500/ ACI 555R

Structural Efficiency

Far too often, buildings are over structured/designed – there is little element of value engineering in the design of the building and the short design period is a reason behind the case. This often adds up the cost as more material is used. It is a dilemma as it does not take much work to engineer accurately; what needs to change is improvements in optimizing engineering design. Engineers must also do their job. Ways to overcome this dilemma is to specify the safety factor early on and stick with it.

Other suggestions to help overcome the over design issue is to design the façade to multiple uses. A team approach where the contactor has a say early in the design process can help push the costs down by getting engineers back to the drawing board to optimize the design. A Design & Build project ensures enough communication and charrettes will provide that necessary platform. Ideally the contractor should come in during the schematic design phase as they are then able to add the most value. There is also the need for local research to help back up / build confidence in preventing over speculation

Healthy and Low Emission Materials

Hotels in Dubai in general have better VOC policies than other building sectors.

A number of chemicals have been banned:

- Annex III Rotterdam Convention
- Annex A, B, and C Stockholm Convention
- Chlorofluorocarbons (CFCs)
- Methylene Chloride
- Perchloroethylene

Known Restricted Chemicals

- Hydrochlorofluorocarbons (HCFCs)
- Halons

VOCs as per LEED/Estidama

Embedded Carbon

Measuring carbon is a likely challenge and not many companies practice it. Examples shared included formulating a personal spreadsheet template, and populating it with the help of online databases that provide information on embedded carbon rates and apparent emission rates.

A contractor provided the example of how they calculate carbon for certain aspects such as diesel use, and switching to bio diesel instead on the site to lower carbon footprint. Other sustainability ventures that can impact embedded carbon values include partnering with a renewable energy supplier to power site offices.

Conclusion

The majority consensus held that education and awareness is critical to ensuring progress is made. And while progress is being made, issues still abound with sustainable procurement and the managing of building products sustainably in a limited GCC market. A common issue that springs up is the lack of infrastructure. For e.g., in the realm of waste management, concrete segregation is a great sustainability practice and strategy, however if there is no infrastructure to support recycling then the effort is wasted. A major roadblock experienced is getting the waste offsite and ensuring that it will be recycled effectively and will not end up in a landfill. Furthermore, local case studies of D-B projects will also help to support the collaborative model as a best practice method.

EmiratesGBC Technical Workshop #2016-7:

Energy Efficiency and External Thermal Insulation Composite Systems (ETICS)

August 16, 2016

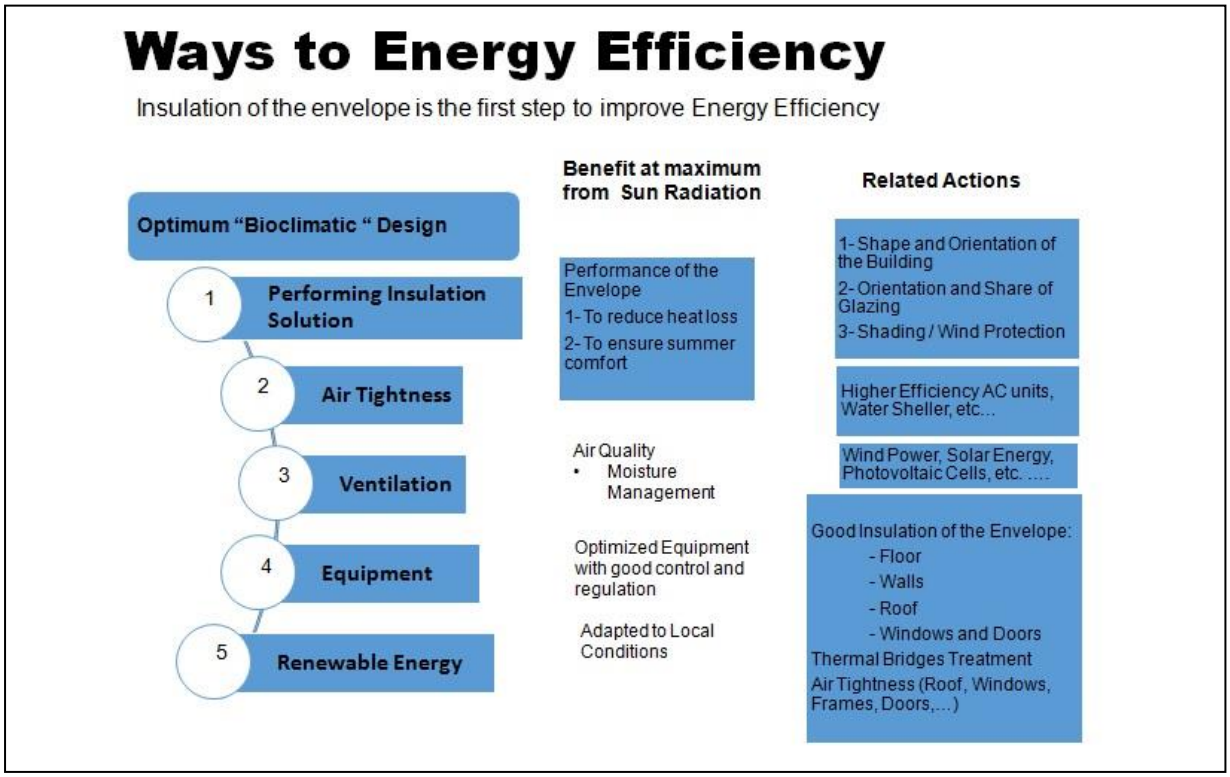
Introduction

With the temperatures soaring in the UAE, there is an advanced and growing need to involve sustainable building and coating methods while maintaining the visual appeal of a structure. On August 16th, the EmiratesGBC Technical Workshop provided participants with a general overview of the ETICS system, challenges of building the system, and the opportunities found in the local and regional market place. Special emphasis was given on the UAE latest green building regulations and fire testing requirements set by the authorities.

Back to basics: Defining of Energy Efficiency and Thermal Insulation

With global and regional trends indicating a continuous increase in energy demand and a still-growing dependency on fossil fuels (International Energy Agency, 2013), the need to consider energy efficiency as a priority for the authorities and the industry increases accordingly. With residential and commercial buildings accountable for 70 to 80% of the overall use of generated electricity in the GCC region, applying sustainable building practices appears as the quickest and most effective way to reduce energy consumption and therefore better manage resources.

In this context, energy efficiency in buildings is seen as the quickest, most effective and environmentally friendly way to extend energy supplies and manage energy use. As one of the key measures to increase energy efficiency, “insulation materials and the cladding systems they are incorporated into can be highly effective in minimizing the energy required to maintain a suitable indoor temperature” (EmiratesGBC Technical Guidelines for Retrofitting Existing Buildings, 2015). As one of the methods of insulating existing materials available in the United Arab Emirates, thermal external insulation allows the reduction of the effects of the various processes of heat transfer between objects in thermal contact. It provides a mean to maintain a gradient of temperature by providing a region of insulation in which heat flow is reduced.



Slide produced and used during an earlier workshop on energy efficiency

Important definitions…

- U-Value: the amount of heat that passes through $1m^2$ of the exterior wall. $(W/m^2.K) = 1/R$ total.
- R-Value: The measure of Thermal Resistance.
- K-Value (λ) (W/m.K): the property of a material to conduct heat. Materials of low thermal conductivity are used as thermal insulators.
- The new Dubai Green Building rating system, Al Safaat, requires a maximum U-Value for walls of 0.57 $W/m^2.K$ (max) for Bronze and Silver levels and 0.42 $W/m^2.K$ (max) for Gold and Platinum levels.
- Thermal Bridges: a fundamental of heat transfer where a penetration of the insulation layer by a highly conductive or non-insulating material takes place in the separation between the interior and exterior environments of a building assembly.

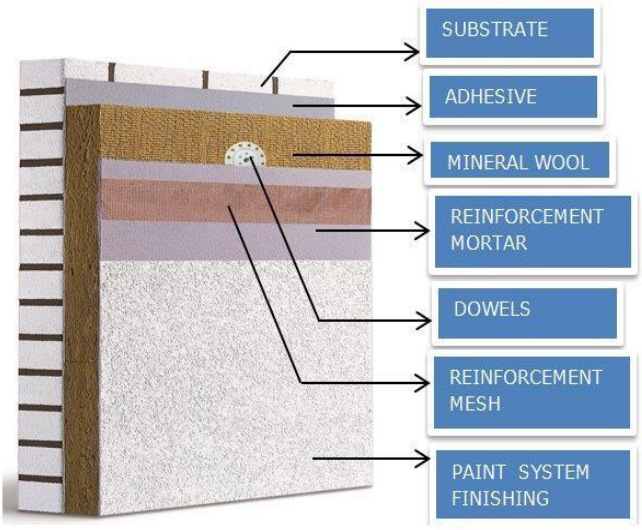
What are ETICS/EIFS Systems?

External thermal insulation composite systems (ETICS) and Exterior Insulation and Finish Systems (EIFS) offer continuous insulation by design, allowing architects the design flexibility and aesthetics they require, while helping to meet the energy codes and improving a building's energy efficiency.

The application of such systems is not only suitable for new buildings; it is also a great solution for retrofitting existing buildings that can be installed retroactively and chosen along with other techniques (e.g. roof insulation, internal wall insulation, wall cavity insulation), which can improve thermal properties of building envelope

The system consists of composite elements which are applied in layers on site. It generally consists of:

- Base Rail
- Adhesive mortar
- Mineral wool insulation boards
- Glass fiber mesh (Heavy Duty/Standard)
- Reinforcing mortar
- Primer coat
- Intermediate coat
- Top coat



The systems can be completed by dowels, corner profile, joint sealant tape or expansion joint ETICS/EIF-Systems is an energy efficient solution as it “encapsulates” the building with a thermal envelope and eliminate thermal bridging, and therefore cost efficient as it improves the buildings’ insulation values and therefore help reduce both running cost and capital costs.

Common problems

Following the review of the products’ key characteristics, the facilitators went through various case studies to present best practices as well as problems related to poor implementation of systems.

One of the main issues is directly related to the actions and sometimes limited experience of the installers in charge of the systems’ application on buildings; by not preparing the substrate properly they can for instance damage the systems or lead to cracks in the façade that will compromise the systems efficacy. It is therefore highly recommended to use a qualified and highly experienced applicator, assess his references and past projects, request references and check his approvals and certifications from local authorities.

It is also critical that all insulation products are categorized, tested and certified under reputable specifications (e.g. ETAG-004, ASTM) and as per the standards required by the local authorities;

“substitutions with a lower quality, lower-priced product is a false economy and will in all probability render the system less effective” (EmiratesGBC).

At last, and as a common limitation associated with insulation systems in the country/region, almost all insulated building blocks suffer from thermal bridges (as manufactured and/or due to adding mortar joints at construction site). Under practical conditions, thermal bridges can increase transmission loads by 100% and increase the U-value by 50% and so energy loses. They should therefore be eliminated since they minimize thermal insulation effectiveness.

Green Building Regulations and Fire Codes

Participants at last had a look at the existing regulations in the country (both on the federal and local levels) and discussed standards set by the authorities with regard to the systems’ and claddings’ key indicators and fire testing and safety. The following were discussed:

In 2003, Dubai Municipality (DM) enforced the green buildings regulations for all newly constructed buildings in Dubai. In July 2016, DM launched the new Dubai Green Buildings rating

system named “Al Safat”, which mandates a U-Value for walls of ≤ 0.57 W/m²K for Bronze and Silver levels and a value of maximum 0.42 W/m²K for Gold and Platinum levels.

In November 2010, the Urban Planning Council (UPC) in Abu Dhabi announced the Pearl Rating System for sustainable buildings which mandates a maximum U-Value for walls of ≤ 0.32 W/m²K.

Discussions between the workshop’s participants highlighted the existing confusion on the market created by the various regulatory schemes to comply with and the numerous authorities to deal with. This confusion makes it harder.

In July 2016, UAE Civil Defense announced the update of its 2011 fire codes but the new Fire and Life Safety Code hasn’t been not launched yet. The new code will include more stringent specifications and requirements regarding fire insulation materials to be installed and the tests that the materials and systems need to pass to be allowed on the UAE market. One can in the meantime refer to the below table that was shared in an official communications from by DCD to suppliers which states the required specifications based on facades systems:

Table 1.15.a.: EIFS and ETICS on Non-Fire Resistance rated and Non-Load bearing Exterior wall coverings-Test Requirements

OCCUPANCY AND TYPE OF BUILDING	TEST 1 EIFS/ETICS COMPONENTS AND PANEL AS PRODUCT	TEST 2 EIFS/ETICS AS WALL ASSEMBLY
1. ANY BUILDING 2. ANY INSTALLATION 3. ANY AESTHETICS	i. All components of the EIFS (All layers including EPS/ XPS, coating, insulation, mesh, adhesive and finish.) shall be class A (Flame spread 0-25, Smoke development 0-450) when individually tested to ASTM E 84 AND ii. NFPA 268 With pass criteria “No Ignition at 12.5 kw/m² at 20 minutes”	iii. BS 8414 –1 Or 2 With pass criteria as per BRE 135 OR iv. NFPA 285 With pass criteria “Pass” OR v. FM 4881 With pass criteria “Pass” OR vi. ISO 13785-2 With pass criteria “Pass”

As of January 2017, the final version of the Code from the UAE Civil Defense is not available yet publicly. The participants however discussed the need for all companies competing in the same sector to cooperate and work with the authorities in order to generate two-ways communications

on critical topics (e.g. feasibility of implementing the mandated requirements, education of the market on new items, testing methodologies and facilities…).

Conclusion

Thermal insulation of buildings presents many challenges in the region, whether technical (construction and application of ETICS), regulatory (approvals from civil defence, new codes and regulations), economic (financing solutions for retrofit projects, market readiness) or behavioural (education and awareness). Despite the confusion generated by the new regulatory schemes and standards related to green buildings and fire codes, whether on the local or federal level, a more stringent focus on thermal insulation will help reduce the carbon footprint of the UAE's built environment while reinforcing the security of its occupants.

Did you know…?

Bioclimatic Architecture: Takes into account climate and environmental conditions to help achieve thermal and visual comfort inside. Appropriate techniques are applied to the external envelope and its openings to protect the building from solar heat

Thermal Insulation: A low cost, widely available, proven technology that begins saving energy and money, and reducing emissions, well installed insulation ensures Energy Efficiency in every part of the building envelope including ground decks, roof lofts, walls and facades.

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EmiratesGBC Technical Workshop #2016-8:

Health + Wellbeing in the Built Environment

September 27, 2016

Introduction

Since the first green building rating system was launched by the US Green Building Council in 1998, building industries around the world have been influenced by an increasing number of rating systems offering an array of criteria that purport to lower the building's carbon footprint. While they are all impactful for the green building industry and have proven to improve buildings' design, construction, operation and maintenance procedures, newly emerging rating systems and/or green building standards maintain that there are still more parameters that need to be addressed which can when implemented further improve the sustainability, livability and longevity of our buildings.

This month's technical workshop approached the topic of improved wellbeing through the lens of accessibility and also discussed specific design methods that are now covered in a new guide known as the WELL Building Standard. Discussions were framed around the question of what makes an already sustainable building more livable; a building where occupants can flourish and, in the case of commercial properties, achieve their productive goals.

Accessibility

When we think about accessibility in our built environment we look at simplistic factors such as ramps for wheelchair bound occupants, or braille for the visually impaired, however, the term accessibility incorporates a wide range of design and construction parameters which can improve mobility and liveability for not only individuals who are wheelchair bound but also building occupants who are temporarily impaired due to either an injury or sickness, or those who are more accident prone due to some physical impediment. Accessibility also addresses those who have neither of the above but routinely use strollers for babies or other wheeled accessories to move around their belongings.

Participants were asked how they feel the country is doing in terms of accessibility. A salient issue that was brought up included neglecting accessibility in the urban environment, despite building

owners owning adjacent property, there is sometimes little consideration taken on how disabled people will move from one building to the other.

Another point of concern was the lack of visibility of disabled people in the country. A culture shift where they are encouraged to come into the public realm where they deservedly have a place can only be made possible if the design of local buildings and urban environment factor in accessibility features for common permanent and temporary disabilities.

Existing Legislation

The existing legislation or voluntary rating systems commonly used in the country:

- Abu Dhabi Planning Regulations
- Dubai Municipality Regulations
- Dubai Green Building Regulations/ Al Sa'faat
- Estidama

Legislations in the country that address accessibility in the region:

- UAE Federal Law, No. 29 for 2006 'In Respect of the Rights of People with Special Needs'
- Dubai Law, No. 2 of 2014 concerning the 'Protection of the rights of those with disabilities in the Emirate of Dubai'
- Article 27 of the Dubai Municipality Building Regulations

In terms of wellbeing the above mentioned legislations address the following characteristics:

Typically Mandatory:

- Indoor air quality – poor IAQ can contribute to disease
- Thermal comfort – is essential for occupant comfort
- Accessibility – legislation is a work in progress
- Lighting – daylighting versus electric lighting

Optional

- Acoustics
- Access to Amenities – public transportation

There was open discussion on how laws are not applicable to the entire country and even the existing laws in the most populated states of Dubai and Abu Dhabi are not mandated as effectively as they should be. In Dubai you also have semi-regulated free zones juxtaposed and having a

market advantage over localities that fall under the jurisdiction of the Dubai Municipality. Currently accessibility in the built environment is lacking. Wheelchair bound occupants are catered to in several places, however hearing and visually disabled people have limited options besides the Airport and Metro stations.

An audit completed of twenty-eight government buildings found only two buildings that were accessible throughout.

Comparison of International Statutory Regulations Concerning Accessibility

A working matrix shared during the workshop provided a gap analysis of different accessibility features addressed by Dubai building regulatory agencies and compared them with that of international organizations. Dubai ranks very low, with only 30% of the legislation covered.

Dubai government agencies are looking to cover these aspects a 100% and override the current lightweight laws.

c Comprehensive coverage p Partial coverage n No coverage

	Dubai	Ireland	Luxembourg	Portugal	Singapore	Spain	Sweden	U.K.	Australia
External Environments and Approaches to Buildings									
Surface Finishes	n	p	p	p	c	p	p	p	p
Crossing Points, Tactile Paving, and Dropped Kerbs	c	n	p	p	c	c	p	p	n
Internal Environments									n
Entrances	c	c	p	p	c	c	c	c	n
Reception Areas, counters, desks and ticket offices	n	n	p	p	c	c	p	p	n
Signage and wayfinding (interior - audible)	n	n	n	n	c	p	p	n	n
Signage and wayfinding (interior - visual)	n	n	p	c	c	p	p	p	n
Signage and wayfinding (interior - tactile)	n	n	p	c	c	p	p	p	n
Transport Facilities*									n
Bus Facilities	n	p	n	n	p	c	p	p	p
Rail Facilities	n	p	n	n	p	c	c	c	c
Specific Building Uses and Outdoor Areas									
Hotels, student accommodation, etc.	n	p	n	p	c	c	p	c	n
Residential	n	p	n	p	c	c	p	p	n
Comprehensive	13	10	8	19	33	48	22	23	3
Partial	11	24	29	33	26	26	47	35	24
None	58	48	45	30	23	8	13	24	55
%	30%	42%	45%	63%	72%	90%	84%	71%	33%

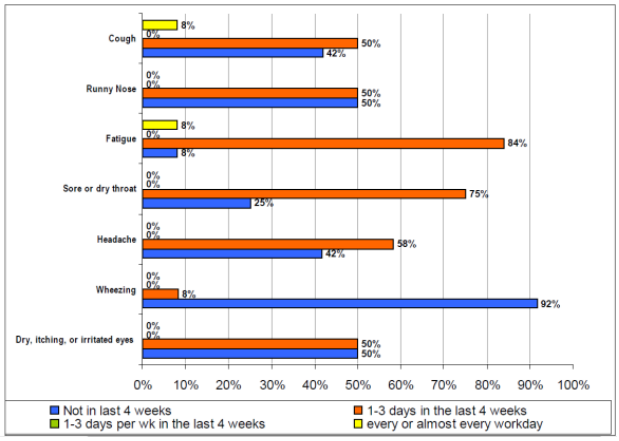
Wellbeing

Numerous studies have shown a strong and positive correlation of productivity, wellbeing and satisfaction with the design of offices and other commercial indoor environments. Building owners who are largely motivated to make investments that lower the cost of utilities such as energy and water are oblivious to these strategies. A recent study conducted by the World Green Building Council titled, Health, Wellbeing and Productivity in offices, showcased the importance of several design parameters and their proven results.

Whether its thermal comfort, better ergonomics in office furniture, or good lighting, wellbeing depends on several factors. A new look into indoor wellbeing has improved from being more than a perspective to becoming a verifiable science. Offices that promote circulation and the measurement of factors that improve biophilia have been catalogued in the WELL Building Standard which was launched in 2014 by the International Well Building Institute. The standard focuses on wellbeing by impacts that can be made by air, water, nourishment, light, fitness, comfort and the mental state of occupants.

Case Study

Local Offices: A local study which measured indoor IAQ in four different offices in the UAE, found that quality of air correlated with several physical ailments which occupants described through a rigorous survey. Ailments included medical conditions such as cough, runny nose, fatigue, headache, depression, dizziness, and tension, among several others.



Schools: Another study which measured IAQ in 16 local schools found the following levels of contaminants in rooms. Most noteworthy is the level of CO2 which has repeatedly been shown to impact concentration and learning ability, so the levels are pretty dismal for a classroom setting.

Pollutants	Measured (Avg.)	Dubai Municipality	Measured (Avg.) LUX	IESNA	Measured (Avg.) dB	Dubai Municipality
TVOC (µg/m³)	815	300	138-742	300	59	35
CO2	1605	800				
Particle concentration (µg/m³)	1730	150-300				

Particle concentration is indicative of the poor air quality in the country due to its location in a desert country. The high numbers measured showed that HVAC systems needed urgent upgrades or maintenance.

Lighting is an important wellness feature to measure and control and it includes a number of variables including color and temperature. For the case study the LUX levels were measured

against the IESNA (Illuminating Engineering Society of North America) standard, and the range of 138/742 shows how high levels could potentially contribute to glare. Sound levels were also recorded above recommended levels by DM. This indicates interruption which can delay concentration by 15 minutes every time students are interrupted.

Wellbeing Statistics

Obese 63%	Diabetic 12.5%
Avg. age for heart attack 45yrs	UAE nations with high blood pressure 40%

Existing Tools

Green Building Tools	**Post Occupancy Evaluation Tools**
• Estidama • LEED • BREEAM • WELL	• Subjective surveys (Berkley Methodology, BUS Methodology) • Physical Measurements

Variables Affecting Wellbeing

- Acoustic quality
- Air quality – it was noted that there are tradeoffs when it comes to better air quality and better energy efficiency and building owners have to pay extra in order to avoid compromising on both.
- Lighting quality
- Thermal comfort
- Office furnishings

The Physical Office Environment

The following parameters are covered in the WELL Building Standard and other sources and contribute to to health and wellbeing:

Biophilia and views into nature	Nourishment	Accessibility	Location & access to amenities
Cleanliness and maintenance	Look and feel	Access to buildings	Access into buildings
Horizontal circulation	Vertical circulation	Facilities in buildings	Emergency evacuation

Salient design features which are becoming increasingly popular in buildings retrofitted for wellbeing:

Active Design Office design which encourages mobility has wide ranging applications. The sky's the limit when it comes to ideas and there are many.	Biophilia Access to natural views on the outside.This also includes adding plants and greenery in indoor spaces.	Look and Feel Adding greenery in the office does not necessarily mean adding plants. The colorful elements.
Hot Desking Building occupants have access to any place where they can sit and work, with each spot primed for lighting and acoustics.	Nourishment Research correlating nutrition with a healthy mindset is now coupled with innovative design methods that encourage people to opt for healthier food.	Signage & Wayfinding There are several innovative ways to guide people around public building such as banks, hospitals, transportation hubs.
Access into Buildings Multiple ways these are achieved as discussed earlier: tactile surfaces, ramps, unobstructed pathways for pedestrians on wheels.	Vertical circulation Elevators that have braille on floor numbers and sound systems notifying the current floor.	Sanitary buildings The height of bathroom features and supporting hand bars.
Emergency Evacuation Again must take into account all levels of disability. This is an important issue and each building faces its unique challenges. A solution that is working impressively is to create and provide each building occupant with their own personalized evacuation plan and protocol based on their individual accessibility needs.		

Incentives

The Dubai government is providing support to all its government agencies through the Dubai Government Excellence Program Awards. These initiatives provide real and tangible incentives for government bodies to create policies that mitigate harm and achieve the governments overarching goals of sustainability. More incentives are also in the pipeline.

Conclusion

With staff costs, including salaries and benefits typically accounting for 90% of business operating costs, it is imperative that owners and the government take building sustainability beyond the MEP realm. Local legislative bodies are actively working on improving accessibility as well taking into account several parameters that ensure a comprehensive retrofit of existing buildings in

terms of improved mobility. The city has to realize its ambitious goal of becoming an accessibility friendly city by 2020. Legislation is the first part of that process, but implementation through active monitoring and enforcement is key.

Meanwhile, sustainability measures incorporating the WELL Building Standard only serve to improve buildings in ways that ensure a holistic step up from the usual paradigm of building longevity to also working towards occupant longevity via health and wellbeing. While there are wellness parameters covered in current local building codes and regulations, the WELL Standard ensures they are effectively actualized with measurable results.

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EmiratesGBC Technical Workshop #2016-9:

Special Technical Workshop to Contractors and Sub-Contractors: Management Systems for Green Building Rating Systems

September 20, 2016

Introduction

Management systems and tools such as the ISO series and processes can easily be implemented and applied to green building projects, as they are built for compliance assessment and provide a good “back bone” to prepare for a green rating application.

In September 2016, Emirates Green Building Council (EmiratesGBC) opened its doors to UAE-based contractors and sub-contractors and invited them to discuss processes and best practices used to implement a green project while guaranteeing safety, efficiency and deadlines.

Requirements from Existing Regulations and Rating Systems

Following a general introduction on EmiratesGBC’ s programs and activities, the workshop’s participants were invited to review some of the existing green building regulations and rating systems that are available in the United Arab Emirates and discuss the implications of their respective requirements onto their work as contractors. Key areas of the “green building” concept relevant to their industry have been emphasized, for instance energy and water efficiency, air quality, selection and use of materials, or the minimization of the projects’ environmental impact; participants were asked to identify challenges and solutions pertinent to the following systems.

Leadership in Energy and Environmental Design – LEED rating systems, US Green Building Council
Aim Promote a transformation of the construction industry through strategies designed to achieve seven goals:

- To reverse contribution to global **Climate Change**
- To enhance individual **Human Health** and well-being
- To protect and restore **Water Resources**
- To protect, enhance, and restore **Biodiversity** and **Ecosystem Services**
- To promote sustainable and regenerative **Material Resources** cycles
- To build a **Greener Economy**
- To enhance social equity, environmental justice, **Community** health, and quality of life

Key Challenges to Contractors

Local sourcing of materials and requirements related to the identification of the right suppliers under specific requirements and budget targets.

Solutions relevant to Contractors

- Develop/request detailed documentation showcasing compliance and create database of preferred suppliers based on rating systems' criteria and requirements.
- Educate the market accordingly.

Estidama Pearl rating system, Abu Dhabi Urban Planning Council

Aim

"*Preserve and enrich Abu Dhabi's physical and cultural identity, while creating an always improving quality of life for its residents on four equal pillars of sustainability: environmental, economic, social, and cultural. […]*

Need to properly plan, design, construct and operate sustainable developments with respect to the traditions embedded within the rich local culture on one hand and the harsh climatic nature of the region on the other." (Estidama Pearl)

Estidama is directly connected to a project's building permit and defines four stages of review and compliance during the construction:

Stage 1 -

- Estidama awareness within Design and Construction Team
- Procurement Strategy
- Construction Waste Management

Stage 2 -

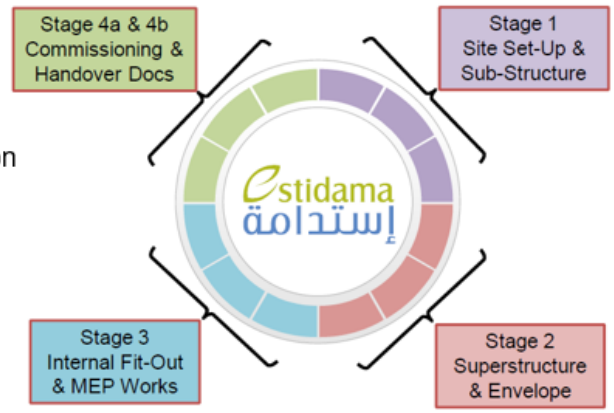
- Envelope verification and inspection

Stage 3 -

- Commissioning activities, results
- Documentation Submittals
- 70-80% of Construction submittals complete

Stage 4 -

- BMS + Draft O&M Manuals
- Final site audit & Envelope Inspection



Key Challenges to Contractors

Stages of review that impact on the project's timeline and costs.

Large amount of documentation to collect and submit to verify compliance to stringent requirements.

Solutions Relevant to Contractors

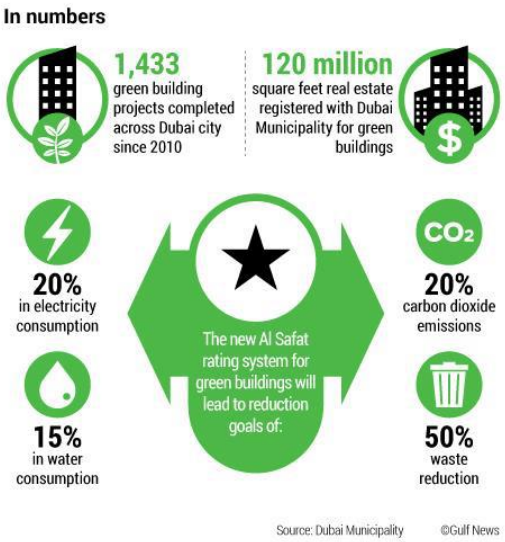
- Technical workshops, trainings and awareness campaigns to educate professionals (contractors and sub-contractors) and other stakeholders (suppliers, owners, consultants…) on the requirements set by Estidama.
- Along with technical trainings, internal demonstration and cooperation to educate teams of compliance with various Estidama stages at the very beginning of the projects.

Al Sa'fat (Dubai Breen Building Evaluation System), Dubai Municipality

Aim

"*Improve the performance of buildings in Dubai by reducing the consumption of energy, water and materials, improving public health, safety and general welfare and by enhancing the planning, design, construction and operation of buildings to create an excellent city that provides the essence of success and sustainable living.*" (Al Sa'fat)

Launched in 2016 and superseding the Dubai Green Building Regulations and Specifications (2011).



Key Challenges to Contractors

Along with above-mentioned other challenges:

Cost of complimentary documents to be provided by suppliers in order to prove compliance too high compared to the advantages these documents can provide to the supplier to strategically position itself on the market.

At the time of the workshop, unclear understanding of the Al Sa'fat framework, technical requirements and processes.

Solutions

Education, trainings and workshops throughout all sectors (contractors, suppliers, consultants….) to understand requirements and processes.

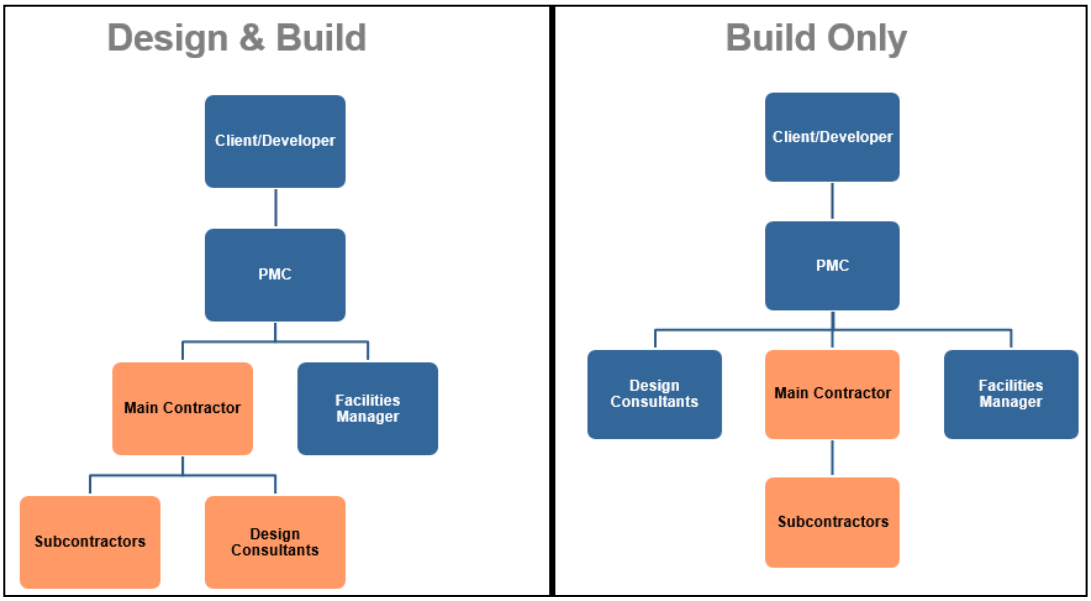
Role of Contractors and Sub-Contractors in the field of Green Buildings and Sustainability

With the above-mentioned standards and regulations in mind, the role of contractors and sub-contractors to implement the regulatory requirements and ensure compliance with "green" principles, is critical; the following tasks can be listed, amongst others:

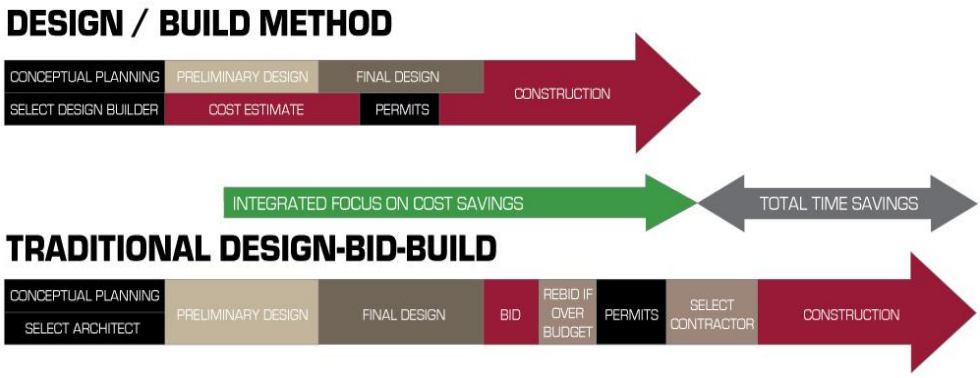
- Early engagement of sub-contractors and stakeholders in the supply chain;
- Development & implementation of site management plans;
- Staff and stakeholders' training;
- Procurement of compliant materials;
- Monitor the impacts from design changes to green building standards and performance;

- Coordination of commissioning activities;
- Tender document review;
- Establishing platform for FM coordination and handover.

Participants then discussed the advantages and challenges of the existing contractual delivery methods, “Design and Build” and “Build Only”, and their respective impact the conduction of green building projects.



By comparing both models participants agreed that “Design and Build” is the one that simplifies the communications between and engagement of the project’s stakeholders, even it concentrates risk in the hands of contractors and sub-contractors. Integrative planning for instance allows for a stronger project planning, reduces time dedicated to planning and implementation, and therefore can help reduce the overall project’s costs. It allows also for a better integration of green building principles and stronger monitoring of compliance throughout the project’s phases.



Challenges related to project management and experienced by the participants were discussed, including the following:

- It is sometimes difficult for contractors to receive all required documentation that confirms compliance with the regulatory requirements and green building rating systems' criteria. The suggested solution was to remind all stakeholders at early stage that compiling and submitting this documentation is contractually mandatory.
- There is sometimes confusion amongst stakeholders with regard to which requirements to follow between the regulatory ones and green building rating systems' criteria. However, if LEED certified professionals can provide guidance to implement a project properly, regulations and specifications are the ones to be respected.

Management Systems and Tools

Management systems are comprised of a framework of policies, processes and procedures. They are "designed to help companies define and achieve performance goals and stakeholders' benefits, while managing the broad and significant range of risks inherent"1 to the nature of projects and borne by the contractors.

Standards such as ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems) or OHSAS 18001 (Occupational Health and Safety Assessment Series) can provide:

- A systematic model to follow;
- A roadmap to identify and design objectives;
- Transparency regarding roles and responsibilities of involved stakeholders; and
- Efficient use of internal resources to:
    - Satisfy the employer and client requirements
    - Comply to regulations and green building rating systems criteria
    - Meet above-mentioned objectives.

Using a continual process during which a project's steps are systematically assessed and if needed corrected, the standards are designed to follow a "PDCA approach":

[1] Operating Management System Framework, IPIECA, OGP Report No. 510, June 2014.

Plan: Establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies. This step includes: legal requirements, compliance obligations, resource allocations, management plans, procedures and manuals, procurement, risk assessment;

Do: Implement the processes. This step includes: material submittals, meetings and tool box talks, trainings, development of logs and registers, awareness campaigns;

Check: Monitor and measure processes and product against policies, objectives and requirements for the product and report the results. This step includes: collecting minutes of meetings, inspections and audits, reports, work inspection reports, material inspection reports, control of documents;

Act: Take actions to continually improve process performance. This step includes: assessment of parties' competencies and the continuous review of targets, timelines and deliverables, policy and procedures, management plans, audits and reports.

Strong leadership in place is critical to implement these management systems and tools efficiently: it emphasizes an organization's commitment and accountability towards best HSE management and sets the right basis to implement a project successfully.

When questioned regarding experienced challenges during the implementation of management standards, the workshop participants highlighted the following:

- Procurement processes can be difficult to implement smoothly as they require a proper balance between regulatory requirements and budget to respect. Accurate budgeting from the very beginning on the submittal level is required.
- Getting the right skillful professionals onboard a project, across all involved stakeholders and throughout the various levels of management, requires proper mapping of resources. This involves implementing a proper collaboration between parties from the project's early stages.

Conclusion

This special Technical Workshop to contractors and sub-contractors allowed participants to exchange on challenges related to project implementation and understand the added value of using management standards and tools as a basis for success in view of the current regulations and green building rating systems that apply in the UAE. Discussions highlighted that education and awareness are key components to ensure a consistent understanding of objectives and processes throughout stakeholders and levels of management. Access to the right skills and information to reach and document compliance to these regulations and standards is also critical and can be managed through stringent project planning and continual assessment of the project's phases. At last the participants indicated their interest in any forum that would allow them to share best practices and support the environmental education of the industry.

EmiratesGBC Technical Workshop #2016-10:

Power Quality Management

September 27, 2016

Introduction

Power quality management is currently one of the most important topics in energy management because as it helps avoid power outages, higher utility bills and the failure of electrical appliances. To properly resolve power quality issues, it is important that the stakeholders such as electrical utilities, electrical equipment manufacturers, suppliers, regulators, and consultants, not only have a common understanding of those issues, but also work in coordinated and cooperative ways to find solutions.

This month's technical workshop approached the source of issues related to poor Power Quality (PQ) and their effects on a buildings operational costs. Discussions focused on how to accurately trace the causes of poor PQ and diagnose the root causes of the problems.

What is Power Quality?

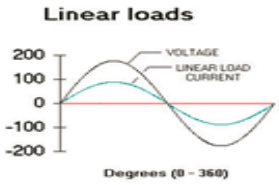
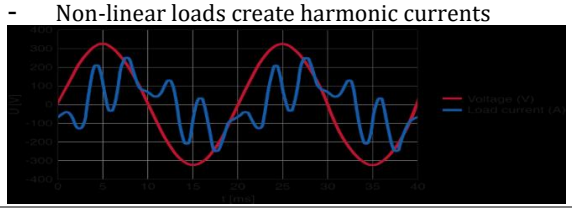
Power Quality (PQ) is a measure of how well the system supports reliable operation of its loads. In other words, it is defined by how well the voltage bus can maintain a pure sinusoidal wave at rated voltage and rated frequency.

Any power disturbance is expressed by the magnitude and duration of the deviation from ideal for either the voltage, current, or frequency. The impact depends on whether this deviation is important or not. For instance, PQ impacts a wide range of phenomena including harmonics, voltage fluctuations, voltage dips, power frequency variations, and voltage imbalance that may disrupt or damage equipment.

Modern Equipment

One of the properties of electricity is that some of its characteristics depend not only on the electricity producer/distributor but also on the equipment manufacturer and the customer. Compared to old equipment, modern appliances create more PQ issues and are highly affected by the power disturbances due to their non-linear-load nature. They can create harmonic currents and cause distortion of the current and voltage waveforms (Refer to the table below showing the difference between linear and non-linear loads).

Equipment like variable speed drives, microprocessor based devices, and loads such as lighting and battery chargers contribute to the quality of electrical power in a circuit and can cause poor power factor, harmonics and power disturbance such as sags, swells, and transients.

	Description	Examples
Linear Loads	- In AC circuits, linear loads' voltage and current waveforms are sinusoidal - The current at any time is proportional to voltage - Impedance remains fixed with changing the applied voltage. - Linear loads don't produce any new frequency (harmonics) or change the applied frequency. 	- Resistors - Capacitors - Incandescent Lamps - Heaters
Non-linear Loads	- Wave shape of the steady-state current does not follow the wave shape of the applied voltage. - The shape of the current waveform is not sine wave - Non-linear loads create harmonic currents 	- Electronic equipment - Electronic discharge lighting - Adjustable-speed drive systems

Power Disturbance Issues

Approximately 80% of all power quality problems occur due to internal distribution reasons related to grounding and wiring systems. For instance, corroded connections, defective electrical devices and loose wiring are main causes to power disturbance. On the other hand, utility transmission and distribution systems are other sources and contribute to 20% of the existing cases.

Symptoms

The main symptoms to power disturbances are, among others:

- Power outages

- Tripping circuit breakers and ASDs
- High utility bills
- Flickering lights
- Equipment running noisy and hot
- Premature equipment failure
- Poor performance & unexpected shutdowns
- Lost data in electronics
- Voltage dips & swells
- Transients
- Noise interference
- Harmonic distortion
- Under / over voltage or current
- Voltage unbalance

Causes

The main PQ issues include: voltage dips, swell, transients, noise interference, harmonic distortion, under /over voltage and voltage unbalance.

Voltage Dips- A decrease of the normal voltage level between 10 and 90% of the nominal rms voltage at the power frequency, for durations of 0,5 cycle to 1 minute.

Voltage Swells- Momentary increase of the voltage, at the power frequency, outside the normal tolerances, with duration of more than one cycle and typically less than a few seconds.

Very Short Interruptions- Total interruption of electrical supply for duration from few milliseconds to one or two seconds.

Voltage Spike - Very fast variation of the voltage value for durations from a several microseconds to few

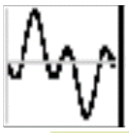
Harmonic Distortion- Voltage or current waveforms assume non-sinusoidal shape. The waveform corresponds to the sum of different sine-waves with different magnitude and phase, having frequencies that are multiples of power-system frequency.

Voltage fluctuation - Oscillation of voltage value, amplitude modulated by a signal with frequency of 0 to 30 Hz.

Noise - Superimposing of high frequency signals on the waveform of the power-system frequency.

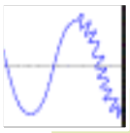
Voltage Unbalance - A voltage variation in a three-phase system in which the three voltage magnitudes or the phase angle differences between them are not equal.

The main causes to the above mentioned disturbances are represented in the chart below:



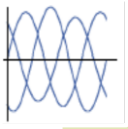
Harmonic Distortion

- *Classic sources*: electric machines working above the knee of the magnetization curve (arc furnaces, welding machines, rectifiers, and DC brush motors.)
- *Modern sources*: all non-linear loads, such as power electronics equipment including ASDs, switched mode power supplies, data processing equipment, high efficiency lighting.



Noise

- Electromagnetic interferences provoked by Hertzian waves such as microwaves, television diffusion, and radiation due to welding machines, arc furnaces, and electronic equipment.
- Improper grounding



Voltage Unbalance

- Large single-phase loads (induction furnaces, traction loads)
- incorrect distribution of all single-phase loads by the three phases of the system

Diagnosis

When testing the PQ, specialists start their measurements at the point between the grid connection and the main distribution panel. Depending on the results of the measurements, further measurements can be done at different points in the system.

Voltage Dips

- Faults on the transmission or distribution network (most of the times on parallel feeders).
- Faults in consumer's installation.

Voltage Swells

- Start/stop of heavy loads
- badly dimensioned power sources
- badly regulated transformers

Very Short Interruptions

- Opening and automatic reclosure of protection devices to decommission a faulty section of the network.

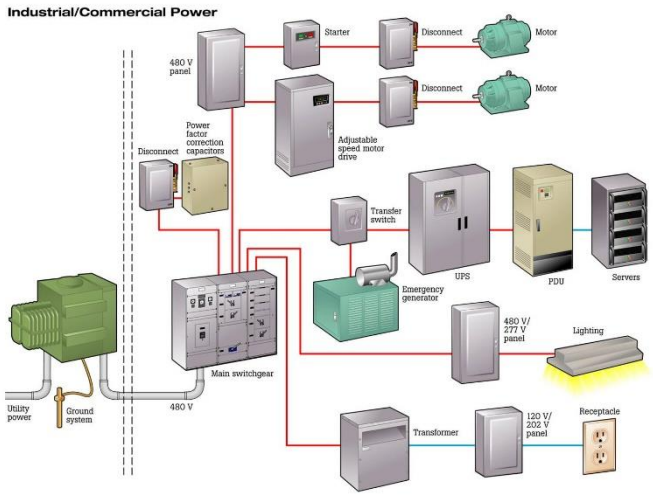
Voltage Spikes

- Lightning
- switching of lines or power factor correction capacitors
- disconnection of heavy loads.

Voltage Fluctaution

- Arc furnaces
- frequent start/stop of electric motors
- oscillating loads.

A poor power quality is usually generated from the functioning of connected loads such as motors and servers. To specify the origin of these issues, it is recommended to measure the PQ at each load. For example, it is recommended to measure the PQ before the VFD of motors to ensure the true PQ is evaluated, and measured against the impact of the VFD.



Applications of Power Quality Management

Monitoring Quality of Supply

PQ monitoring is the process of gathering, analysing and interpreting raw measurement data into useful information. It is often done to provide knowledge about real PQ levels, trends and methods to improve the system-wide power quality performance. It can also be used to monitor emissions from industrial customers, optimise contracts between suppliers and consumers, and support the optimisation of the electric network.

Disturbance Analysis

The power disturbance analysis is a major element in PQ management to reduce downtime and prevent similar disturbance. The analysis also supports in monitoring the performance of protection devices and improving maintenance.

Network Optimization

The control of the power quality can reduce the energy bills (peak demand costs) and optimize the electric network. For instance, testing and monitoring of the PQ in a facility can prevent overloading, improve the balance between loads and reduce the neutral currents to safe ranges.

Predictive Maintenance

Unlike a comprehensive electrical system survey, predictive maintenance power quality focuses on a small set of measurements that can predict power distribution or critical load failures. By checking the power quality at critical loads, you see the effect of the electrical system up to the load, detect and anticipate PQ issues, monitor harmonic levels and locate the cause of dips/swells or hotspots.

Power Quality Standards

Some of the main standards to measure the PQ which have been adopted by the industry and mandated by several government authorities are summarized below:

- IEEE 519- Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
- IEC 61000-3-2 and IEC 61000-3-4- specify limits for harmonic current emissions applicable to electrical and electronic equipment
- IEEE Standard 141-1993- Recommended Practice for Electric Power Distribution for Industrial Plants
- IEEE Standard 142-1991- Recommended Practice for Grounding of Industrial and Commercial Power Systems
- IEEE Standard 446-1987 - Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
- IEEE Standard 1100-1999- Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- IEEE Standard 1159-1995- Recommended Practice for Monitoring Electric Power Quality
- IEC Standard 61000-4-15 - Defines the measurement procedure and monitor requirements for characterizing flicker

Conclusion

The consequences of power disturbance may vary from inconvenience to actual shutdown of production facilities putting human lives at risk. However, several viable solutions exist which can help avoid these disturbances. For instance, employing specialists to define, implement and maintain these solutions is the best first step to take.

Measurement of power quality requires the use of proper instrumentation to suit the application and benchmarking of the measured data with the existing norms and standards. PQ testing and diagnoses of the origin of the problem can help avoid the need for adding more devices to reduce the symptoms of a poor PQ.

References

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EmiratesGBC Technical Workshop #2016-11:

Building Energy Modelling – an introduction

November 8, 2016

Introduction

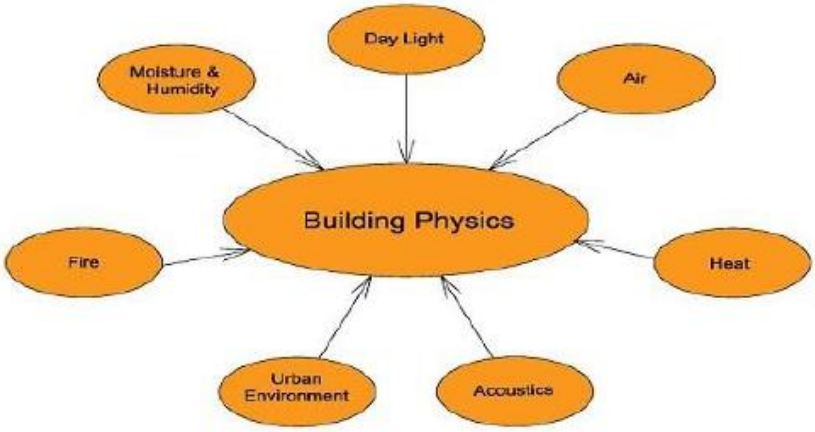
Whether working on a new build or a renovation project, building performance simulation software can allow professionals to test different design options, identify best passive solutions, compare low-carbon technologies, and draw conclusions on energy use, CO2 emissions, occupant comfort, light levels, or airflow. They also allow to test various scenario based on the existing green building regulations, standards and rating systems in order to assess the achievability of performance targets and implement the most relevant solutions to reach them.

During the session, participants were introduced to the purpose and opportunities raised by using performance modelling. They were also given an introductory overview of how to use various simulation options available within the IES Virtual Environment platform.

Understanding Building Physics

The first required step as a user of any building performance simulation is to understand the intent of the simulation exercise itself, i.e. what are the information to extract that will be relevant to specific projects and allow to optimize their performance. Participants identified energy modelling as the best ways to optimize energy use of a design by understanding flows as well as the interactions of a building with its surroundings.

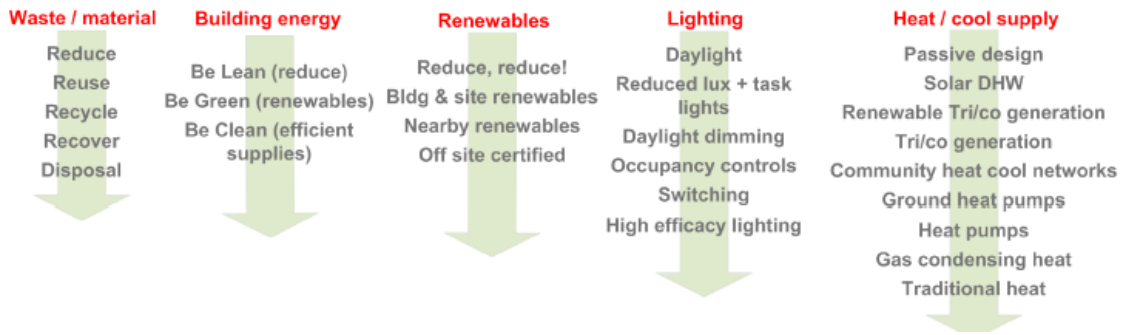
Taking into account building physics is a prerequisite to choose the most relevant passive ways of making a building more energy efficient: while equations could be used to manually calculate for instance heat flows, modelling software can help develop 3D visuals, take into account change in geometry and better integrate various factors that could not be actively accounted for within a “regular” spreadsheet. Various elements and variables that interact with the building which are dynamic in nature and with time will require the support for computerized algorithm.



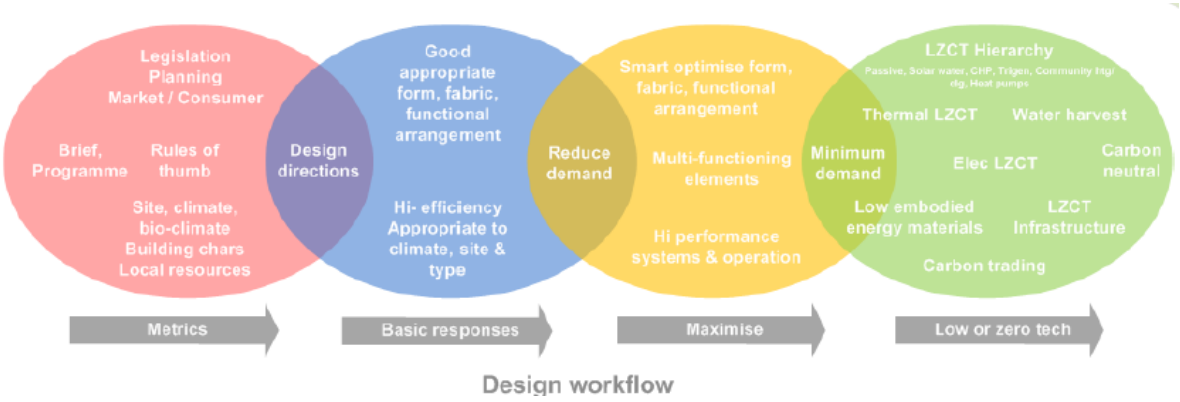
Simulation will combine passive and active solutions to reach out a more energy efficient design. Including all these variables will increase the accuracy of the predictions and therefore allow for better strategies to be implemented: without accurately defining a building's energy profile, reaching proper energy efficiency cannot be possible.

Optimizing energy and environmental performance

The understanding of our built environment, and more specifically of what the concept of "green buildings" entails, has changed over the past years. It now takes into account a lot more items that are relevant to operations management or to the occupants' perspective, for instance well-being, comfort, waste management, indoor air quality…The "old way" of conducting energy modelling was not able to integrate these indicators; this therefore raised the need for comprehensive platforms that can integrate all these factors simultaneously in order to assess how a building performs, how this performance can impact the tenants, and what strategies can be implemented to improve it.



Existing green building standards and rating systems are then to be used and incorporated in the models in order to assess and benchmark the results of a performance modelling exercise against the regulatory requirements, and to implement best practices that will complement the simulation's results.



Design workflow

Concluding the discussions on the purpose and benefits of building performance modelling, the workshop's facilitator reminded participants that the opportunities for improvements of energy performance lay in the list of items that can be simulated beyond the usual technical range, including for instance CO2 management, comfort management, choice of systems to install, retrofit strategies…

Energy Modelling Workflow, Input and Limitations

Prerequisites and limitations of accurate energy modelling were then discussed along with the workflow to proceed best:

→ Understanding the purpose of conducting energy modelling study

→ Early Stage Analysis and Detailed design analysis

→ Applying the simulation to Retrofitting/New Construction/Mixture/Energy Audit with linking BMS and Simulation tool

→ Targeting A Green Rating System Credits

→ Timeframe for Simulation Process

→ Project Information Availability

While energy modelling software already include a large set of variables, indicators and information that can be used as default ones, the accuracy of the results will depend on the level of inputted data at the early stage of the exercise.

In the case of retrofit for instance, Building Management Systems (BMS) and other automation systems can help collect data that can be considered accurate source of information (i.e. records genuine realistic data on operations instead of averaging the information) to be be fed into the simulation. Both BMS and modelling software can even be connected with each other to facilitate the process. Results can be then compared to existing benchmarks and used to develop energy efficiency strategies and come up with measures regarding optimization/reduction of energy consumption. Various simulations will also allow to test and compare scenarios and their technical and financial impact, and therefore facilitate decision making.

Based on their respective experience, participants agreed that conducting a performance simulation for retrofit is preferable at the design phase. In the case of a retrofit project however, it makes especially sense if energy efficiency has not been taken into account earlier by existing buildings. The exercise will especially not be useful in case the existing building already performs well and if all its systems are properly installed, operated and maintained properly.

In the case of retrofit-related simulation, accurate design information will need to be included as well as list the materials and equipment in place. Original drawings will need however to be complemented with specific tests in order to assess the extent to which these materials have lost performance with time (e.g. insulation materials, glazing…).

Participants then discussed the limitation of simulation software and the results that they generate. They identified a few items that are unfortunately either hard to capture, or not taken into account at all in the systems, for instance:

- The characteristics related to the evolution of performance and time-dependent properties of building materials that can decrease and that can only be assessed through proper testing;
- the impacts of man-made actions during the construction phase: the design can be optimized with the use of simulation in order to reach the highest energy efficiency; however if the construction and installation of systems and equipment are poorly executed the benefits from the simulation can be reduced if not cancelled;
- energy modelling software do not take into account at this stage the relationship of a building with the topographic elements of the development site (e.g. lake, pond next to the building…) which can impact for instance humidity, soil quality, etc…

In case elements in the design cannot be measured and therefore fed into the system prior to the simulation's start, the modeler will need to work around things that cannot be modelled by making assumptions and introducing correction factors with the aim to represent the project's real conditions as close as possible. These assumptions need to be realistic and comply with regulatory frameworks and local standards.

Modelling Inputs

To finalize the introduction to energy performance simulation, the list of items and indicators that need to be entered in the modelling phase has been addressed:

These items can be classified into 3 main categories:

Category	Purpose	Source
Geographical location (climate)	Accurate load calculation based on external environment	Weather file
Geometry • Plan • Section • Elevation	Model geometrical attributes of buildings and any site specific features (shading, reflection by tree or building)	Architectural drawings
Construction • Wall • Roof • Window • Overhangs	Model building envelope attributes for thermal load and daylighting calculations	• ECBC • ISHRAE • CBRI • Software library • Vendors • ASHRAE
Daylighting and lighting • Layout • Technology and controls	• Visual comfort • Reducing LPD • Integration with daylight	• Lighting consultant • Vendors • ISLE/IES
Internal Load • Usage (e.g. number of hours) • Schedule • People, equipment, lighting	Accurately capture sources of internal heat gain within building	• Client • Energy modeler • Benchmarking data • Nameplate data
HVAC (type and controls) • Component specification • Control strategy • Layout and distribution	• Sizing the system • Design optimization • Comfort satisfaction	• HVAC consultant • ASHRAE/ISHRAE • ARI • ECBC

- Geographical details and geometry, e.g. weather-related information and physical siting, impact of surrounding natural and built items, expected architectural features;
- Construction-related features, e.g. dimensions of rooms, location of specs and furniture if relevant knowing that mass will impact on heat storage and flow inside a room;
- Equipment and fixtures as well as space specifications of the building that will have an impact on the overall operations, such as occupancy densities, lighting, HVAC…

Participants discussed again the impact on the results' accuracy if certain of the above-mentioned items cannot be listed and therefore fed in the system. The following were discussed as best practice:

If the information is not available for a specific project for instance through BMS records, the modeler should refer to the relevant building standard that will provide requirements to use as default ones.

Details on specific HVAC systems should be provided by the MEP engineer; in case assumptions are made instead of inputting the exact information, accuracy will vary based on the systems that are assumed.

Along with the above-mentioned point, if a simplified system is chosen as default and fed into the analysis as part of the project's characteristics, the software will automatically calculate the flow based on the needs of specific rooms. Modelling software generally host a library of commonly-used systems that are installed in similar buildings; data relevant to these systems can then be automatically sized by the program and applied to the project based on the building/rooms' specifications set by the modeler.

Participants then discussed the benefits that policy makers would get from using and learning from energy performance modelling. It was suggested that using building performance modelling would allow the regulatory bodies not only to test the efficacy of the regulations on specific items (e.g. the requirements for siting, glazing, U-Value…), but also to assess the feasibility and efficacy of these regulations based on the actual availability of materials and equipment on the local market.

Conclusion

Concluding the workshop, participants were introduced to the IES Virtual Environment application in order to see a live example of building simulation and the type of input that a software can take into account, for instance shading on windows, energy flows, HVAC systems, scheduling of

window opening etc…With this live simulation, participants were reminded that critical analysis of numbers and results is the best way to help an owner or occupants strategize on how to design and operate the building best.

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EmiratesGBC Technical Workshop #2016-12:

Optimizing Energy Consumption

December 13, 2016

Introduction

Most modern buildings are comprised of several complex systems with myriad interactions; the sequencing and calibration of these interactions are essential for a productive and sustainable environment. Existing and new buildings in the UAE are prime candidates for energy optimization – a process that helps building operators achieve a balance between the wear and tear of a buildings elements while maintaining its efficiency. December's technical workshop looked into several methods which elicit building sustainability through synergistic models which are explained below.

Energy Optimization vs. Energy Reduction

Currently, buildings in the UAE follow ASHRAE standards for minimum indoor comfort at optimum energy use levels. Energy Optimization differs from energy reduction through its emphasis on people and their influence on a building's efficiency. Too often green rated buildings are unable to deliver the energy reductions that they are certified for, as the personnel who maintain these energy intensive systems are either unaware or do not have the capacity to optimize the functioning of these systems. Or at other times, intervening in a buildings operation by implementing energy saving methods typically backfire as occupants "rebel" because of reduced comfort levels.

Performance Gap

The performance gap is simply the variation and/or discrepancy of what is intended during the design and construction of a building and the changes that occur during its occupancy/operational stage. What is becoming a repeated trend is that buildings are typically constructed sustainably and in compliance to an international or local sustainability standard, end up using vastly more energy during their operational stage.

CarbonBuzz is a web-based platform that allows for the input of building energy consumption data from design through to operation, highlighting the performance gap. The database, which has been gathering building energy data since 2010 shows that, on average, these buildings consume between 1.5 and 2.5 times predicted values. Many other building performance evaluation research programs in Europe and the US have shown similar discrepancies; sometimes up to five times the predicted values.

A number of variables can create this discrepancy. Small changes which can start even in the design stages can create changes in expected energy use, or regulated energy use. Changes in building aspects such as IT infrastructure (not usually looked at during design phase), plug loads, additional functions (swimming pools), operating hours (small changes do add up), to facility management schedules/practices can undermine the intended energy use and lead to wastage. The final three variables have the greatest impact on energy use as they have a multiplier effect across all energy end-uses; for example, an extra hour of building operation will result in an extra hour of lighting, ventilation, cooling and plug loads.

Figure 11. CarbonBuzz Performance Gap Energy Bar: icons represent variables which affect a buildings performance gap. For more information see www.carbonbuzz.org

Reasons for Performance Gap in the UAE

Workshop participants provided their reasons as:

- Overdesign of mechanical systems: in an effort to comply with safety factors and de-risk a project for the relevant consultant. This is difficult to regulate, which is why systems continue to operate in part-load conditions.
- Design rush-through: pressure to meet stringent deadlines in the construction chain leads to the overlooking of errors and omissions in the construction stage.
- Copying: simply duplicating a building that has similar design features can bring about a performance gap as the building's occupancy requirements would be different.

- Lack of standardization: Different equipment, criteria and design processes/methods adopted from different parts of the world can bring a lack of homogeneity in the design process.
- Variation from design intent: often buildings are used differently than what they are designed for.
- Lack of sufficient controls in the building: or building controls are present but training may suffer and sophisticated building controls are run on manual mode. An example presented was a building in Abu Dhabi where the FM team were not qualified to target operating issues in the BMS system and neglected the energy efficient settings in the controller for over a year before the problem was targeted.
- RCx (recommissioning) requirements: commissioning data needs to be verified more than once before it can be determined whether operating parameters match with design parameters. Re-verification at full occupancy and seasonal commissioning are recommended.
- Lack of awareness: A building owner is simply not aware of the implications of cost-cutting and the impact it might have on the longevity of his/her building equipment. Building owners in the UAE are typically very reluctant towards purchasing maintenance contracts.
- Maintenance neglect: not maintaining AHUs properly can contribute to significant inefficiencies in the HVAC system or lead to a breakdown in equipment. Energy recovery wheels are often not maintained properly.
- Short-term thinking: lack of communication/contribution between people who operate the building and the people who design the MEP systems. Safety factors are determined without the input of the O&M department who may have their own processes. Usually FM contracts are short term – typically when there are varied stakeholders in a building's ownership and occupancy – and short term FM contracts inevitably do not include provisions or activities for the long-term efficiency of the building and its systems.

Performance Gap Reduction Strategies

With the growing awareness of the building performance gap, some participants shared their views on proposed solutions that might help reduce energy consumption and bridge that gap. In order to design any effective intervention, one must first understand the scale of the problem and have a baseline that any changes can be measured against. A strong set of building performance benchmarks is necessary for a baseline and there is already much work in the pipeline on this;

- EmiratesGBC recently published its landmark benchmarking report which highlights the energy and water use of over 40 hotels in the UAE.
- Dubai RSB (in attendance) announced the preliminary stages of a new existing building rating system which is being developed in conjunction with Dubai Municipality, Dubai Supreme Council of Energy, Dubai Land Department and Trakhees. The aim is to supplement the new Al Sa'faat Rating System as well as provide a comprehensive and bespoke set of benchmarks that will help to understand the performance gap here in the UAE and eventually provide the basis from which to mitigate it.
- Dubai Supreme Council of Energy (DSCE) has been conducting its own mapping of Dubai buildings, collecting and analysing data on energy use intensity, with the aim to provide a benchmark of where buildings stand in terms of their operational efficiency.

In terms of new construction, have the energy efficient design specifications carried over into the operations and maintenance manuals. Have the facility managers periodically reference these manuals to properly understand how to run their buildings.

BSRIA Soft Landings

'Soft landings' is the BSRIA-led process designed to assist the construction industry and its clients to deliver better buildings. It is a method which integrates into the design process certain measures that help prevent the expected future performance gap; i.e. the discrepancies in design intentions and operational outcomes. It requires a strong dedication from all stakeholders (owners, designers, contractors, and O&M personnel) all the way from the design stage to the occupancy stage. It also requires the whole building team (operators, facility managers) to be involved from the beginning, so a building is designed in a way where it can actually be maintained. In summary, soft landings:

- Helps solve the performance gap between design intentions and operational outcomes
- Require clients to appoint designers and constructors to stay involved with their new building beyond practical completion and into the critical initial period of occupation.
- Assist building managers during the first months of operation with tasks such as helping fine-tune and de-bug the building's systems, and,
- Enable longer, less intensive period of aftercare lasting for up to three years, where energy use and occupant satisfaction is monitored and the operation of systems is periodically checked through seasonal fine-tuning exercises.

Soft landings takes on various stages, see Figure 2 below as well as References:

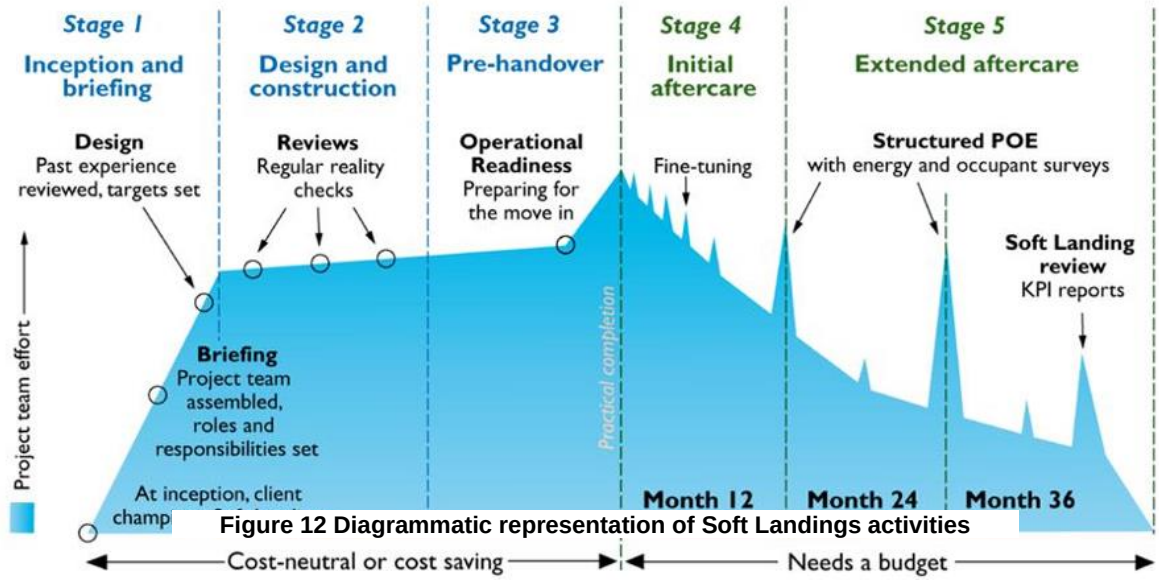

Figure 12 Diagrammatic representation of Soft Landings activities

- Stage 1 – Inception and briefing – this stage involves all stakeholders as discussed earlier.
- Stage 2 – Design and construction – entails regular reality checks against energy targets, budget, building usage, as several factors can change through the design and construction process.
- Stage 3 – Pre-handover – this involves training of building operators and facility managers, and making sure building documentation is up to date and streamlined with the changes that have taken place during the previous stages.
- Stage 4 – Initial aftercare – this preferably is a yearlong stage where building systems are fine-tuned with seasonal changes and different occupant behaviour patterns. It requires a yearlong study of behavioural patterns and continuous education of occupants to mitigate potential problems.
- Stage 5 – Extended aftercare – For up to a three-year period, there should be periodic check-ins and audits which ensure everything is running as planned from the very early design stages.

Soft Landings - Hurdles

'Soft landings' requires a monetary investment and this is typically proportional to the level of commitment and awareness of decision makers.

Post-Occupancy Evaluation

In addition to audits, spot checks, and triangulation of energy use data, a post-occupancy evaluation typically helps determine reality from perception by:

- Obtaining a systematic evaluation of opinion about the building in use; this is the perspective of the people who use the building regularly,
- Fine tuning new buildings,
- Developing new facilities,
- Managing 'problem' buildings by providing reports and recommends to remediate problems,
- Preparing for refurbishment if needed.

Post-occupancy evaluation – in UAE

The public sector in the UAE is driving energy efficiency in the country. This has been relatively smooth sailing as the primary stakeholders in this case, the owner/client/customer are already convinced of the advantages. Simple strategies they employ such as retro-commissioning have already established a 2-year payback period; other strategies implemented such as fine-tuning control loops and sensor calibration can bring in 15% savings. Changing mechanical set points, recommissioning HVAC systems all the way can bring in another 4-5% in savings. Again, not Soft Landings per se, but a similar method and also unfortunately it is only applicable to existing public buildings in the UAE because the client is following its own energy mandate. However, it is hoped that the results that come with these methods will incentivize and provide a business case for the private sector.

Building Case Studies

United Kingdom

A British school conducted a 2-yr post occupancy evaluation of its facility. The school is entirely mechanically ventilated, and classrooms are located around a central atrium. The building uses ground source heat pumps as the lead system with back-up gas-fired boilers. Heat recovery is

Figure 13 Case Study

also utilized in the server rooms and ICT classrooms. Typical systems monitored included heating, AHUs, lighting, pumps, and controls.

After analysing data and modelling it according to the designed intent, they found a slight discrepancy in certain systems such as lighting, but a major jump in energy usage through the fans, pumps and controls energy consumption as well as the heating load. The determining cause of energy wastage was poor installation of systems as well as an overdesign of the mechanical system – the school despite its large size was functioning on only one schedule.

Moreover, if one section needed to be used, the entire school would power up. The Variable Speed Drives (VSD) installed were actually locked and all air handling units would power up if turned on for just one classroom. The root cause of the problem was determined to be variability in the intent of the building from design stage and construction stage to major discrepancies in the operational stage.

United Arab Emirates

Participants that conduct energy retrofits outlined their practices as very similar to soft landings. However, they work on existing buildings and the soft landings process refers to new construction only. An example shared included a retrofit project that required optimization of the chiller systems. The ESCO also included one year of post-retrofit support on proper operation of the chillers which was conducted weekly or daily if needed. This was more than just a courtesy but a crucial aspect of the retrofit process as the ESCO had estimated the savings, and so they must ensure returns come in as guaranteed. Hence it is necessary that the chillers were handled optimally by trained personnel.

Looking Ahead

Influencing the private sector requires effort in terms of generating demand through effective incentivization techniques. Efforts are already being made by different sectors as mentioned earlier, however, the private sector is already rising up to their unique regional challenge and influencing demand through various means - as cited during the workshop, a number of start-up companies have already made headway by investing in the right talented people and good calibrated equipment, determining their own financial strength, and inspiring confidence among potential clientele before they even attain RSB accreditation.

As this sector continues to leverage itself in the market and as data trickles down from the public sector, it is likely that the cost effectiveness of conducting post occupancy evaluations to determine potential energy savings will be its own incentive.

Technological Solutions

There are many solutions out there, noting the most popular ones:

- Electrical network optimization: the electrical load that is delivered to appliances can be excessive which can shorten their lifespan. Optimization can also save energy through lack of wastage.
- Retrospective – implementing meters with transparency in data sharing and analyses may not directly bring about savings, but can identify saving potential.
- Operations – Helpful with AHUs, but also in general, get the building systems to work independently but enable control through a sophisticated central hub
- Feed-forward into design – Again with the HVAC system, zoning building interiors based on the variations in temperature (floor stratification) can lead to significant improvements in environmental quality. The same applies with lighting systems where certain areas that can be shut down are still operating after work hours.

Conclusion

With energy savings proven up to 15 to 20% with simple HVAC enhancements, it is evident that post occupancy evaluation and maintenance is a beneficial method to utilize after the construction and hand over of every new building. Estimating the difference in savings with buildings that are regularly maintained with those that aren't, by creating projection models can help clarify the potential cost implications of neglecting important building systems.

Designing a building on a particular performance metric, while the operational points depend on the end user or operator, typically leads to a huge performance gap and this drives large energy consumption rates as the system is running. Another problem is also oversizing systems, or ending up with systems that are not operating at the optimized set point. Building Information Modelling (BIM) was brought up as an efficient way to predict energy use. However, it was agreed that the solution lies in going beyond BIM, and creating a digital duplicate of the structure, but also with informing and establishing several building operating aspects at the very initial design

stage so that building design, construction, and operations eventually align with occupant behaviour and schedules.

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